# APPENDIX M

# Scofield Island Restoration Area Design Analysis

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# SCOFIELD ISLAND RESTORATION AREA DESIGN ANALYSIS

## 1.0 INTRODUCTION

The Scofield Island Restoration Area Design Analysis was completed in support of the Preliminary Design Phase for the Riverine Sand Mining / Scofield Island Restoration Project (Project). The Project is sponsored by the Louisiana Department of Natural Resources (LDNR), State of Louisiana Office of Coastal Protection and Restoration (OCPR), and NOAA Fisheries. The Project design is funded and authorized in accordance with the provisions of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) (16 U.S.C.A., Sections 3951-3956) and has been approved by the Public Law 101-646 Task Force. The Project's CWPPRA designation is BA-40.

### 1.1 Design Goals

The design goals for the Scofield Island Restoration Area included protecting and preserving the structural integrity of the barrier shoreline by closing breaches and tidal inlets, restoring the beach and dune system with Riverine sand, and increasing the island width with back barrier marsh creation utilizing offshore sediments to increase longevity and create natural resource habitats as fully described in the Preliminary Design Main Report.

The scope of services included detailed review of prior assessments, evaluation of historical survey and land loss data, coastal processes analysis, design of restoration plan alternatives, alternatives analysis, geotechnical analyses, calculations of habitat acre evolution over time, and cost estimates. The design analysis was conducted by Coastal Engineering Consultants, Inc (CEC) and SJB Group, LLC. (SJB).

### 1.2 Summary of Prior Work

Two planning-level assessments for Scofield Island restoration were conducted in 2004. Applied Technology and Management (ATM) prepared a Phase 0-Level conceptual design and engineering analysis report for NOAA Fisheries. ATM (2004) evaluated shoreline change, conducted cross-shore modeling, prepared a sediment budget, and developed a conceptual design of Scofield Island. ATM concluded that the Project would result in significant improvements in reducing island recession and maintaining existing and constructed marsh habitat. Based on this assessment, the CWPPRA conceptual restoration plan included the construction of approximately 429 acres of dune and supratidal habitat and marsh platform.

Coastal Planning and Engineering (CPE) also prepared a Technical Assessment for NOAA Fisheries in 2004 to determine whether Scofield Island barrier restoration could be accomplished by mining and transporting sand from the Mississippi River (CPE 2004). The Technical Assessment was a preliminary investigation into feasibility issues such as available sand resources, pipeline routes, sediment transportation, dredging methods, project coordination and constraints, and estimated construction costs. CPE identified three potential sand targets and two potential pipeline routes from the Mississippi River to Scofield Island.

Subsequent to the 2004 ATM Technical Assessment, a feasibility-level sand search was funded by the Louisiana Coastal Area (LCA) study. Geotechnical and geophysical investigations conducted in 2005 by CPE for LDNR identified potential sand sources for beach restoration and further delineated borrow sites at Nairn and South Pass in the Mississippi River. This work produced preliminary estimates of sediment grain size, thickness, and volume of the sand deposits within the River in proximity to the Project area.

In the Project's Plan Formulation and Feasibility Study Phase analyses (SJB and CEC, 2008), the Scofield Island restoration plan was updated based on the ATM conceptual design and recent island surveys. Volumes for beach, dune and marsh restoration were computed and feasibility level cost estimates were prepared. Two borrow areas were identified in the Mississippi River containing sufficient quantities of beach compatible sand and the Conveyance Corridor was identified through which the sediment pipeline would transport the sand from the river to the island. It was concluded that the Project was technically feasible and recommended to advance to Preliminary Design.

The surveys and analyses completed in support of the Preliminary Design Phase for the Scofield Island Restoration Area included the Mississippi River Borrow Area Design Analysis (Appendix E), Environmental Mapping of the Conveyance Corridor and Scofield Island (Appendix H), Scofield Island Offshore Borrow Area Design Analysis (Appendix J), Scofield Island Back-Barrier Geotechnical Analysis (Appendix K), and Scofield Island Native Beach Sediment Analysis (Appendix L).

## 2.0 PROJECT AREA AND SETTING

Scofield Island is a 2.4 mile long barrier island located between Scofield Bayou and the merger of Bay Coquette and the Gulf of Mexico along the Plaquemines Barrier Shoreline, in Plaquemines Parish, Louisiana. The project is located in Region 2, southeastern edge of the Barataria Basin, Barataria Barrier Shorelines mapping unit, approximately 11 miles west-southwest of Venice. A location map of the Scofield Island is presented in Figure 2-1.

The barrier shoreline at Scofield Island has historically experienced a significant gulf-side erosion rate. Wetlands, dune and swale habitats within the Project area have undergone substantial loss due to oil and gas activities (e.g., pipeline construction), subsidence, sea level rise, and marine and wind-induced erosion causing landward transgression, and more recently, breaching and breakup. Marine processes acting on the deltaic headlands suspend and redistribute previously deposited sediment. Development of fragmentary islands from breaches in the barrier headland, and subsequent inlet formation, have resulted from increased tidal prism storage and storm related impacts.


Figure 2-1: Location Map.

## 3.0 SURVEYS

### 3.1 Historic Shoreline and Land Loss Changes

Williams et al. (1992) examined the magnitude and impact of shoreline change along the Louisiana coastline including Scofield Island. Their technique for shoreline mapping included comparing topographic or near-vertical aerial surveys over time. The high-water line was used as the shoreline for comparison purposes. Between Scofield Pass and Bay Coquette, eight profiles (USGS Profiles 93 through 100) were analyzed (Figure 3-1). Between 1884 and 1988, their derived shoreline changes ranged from approximately (-)390 feet to (-)3,491 feet with an average of approximately (-)1,716 feet.

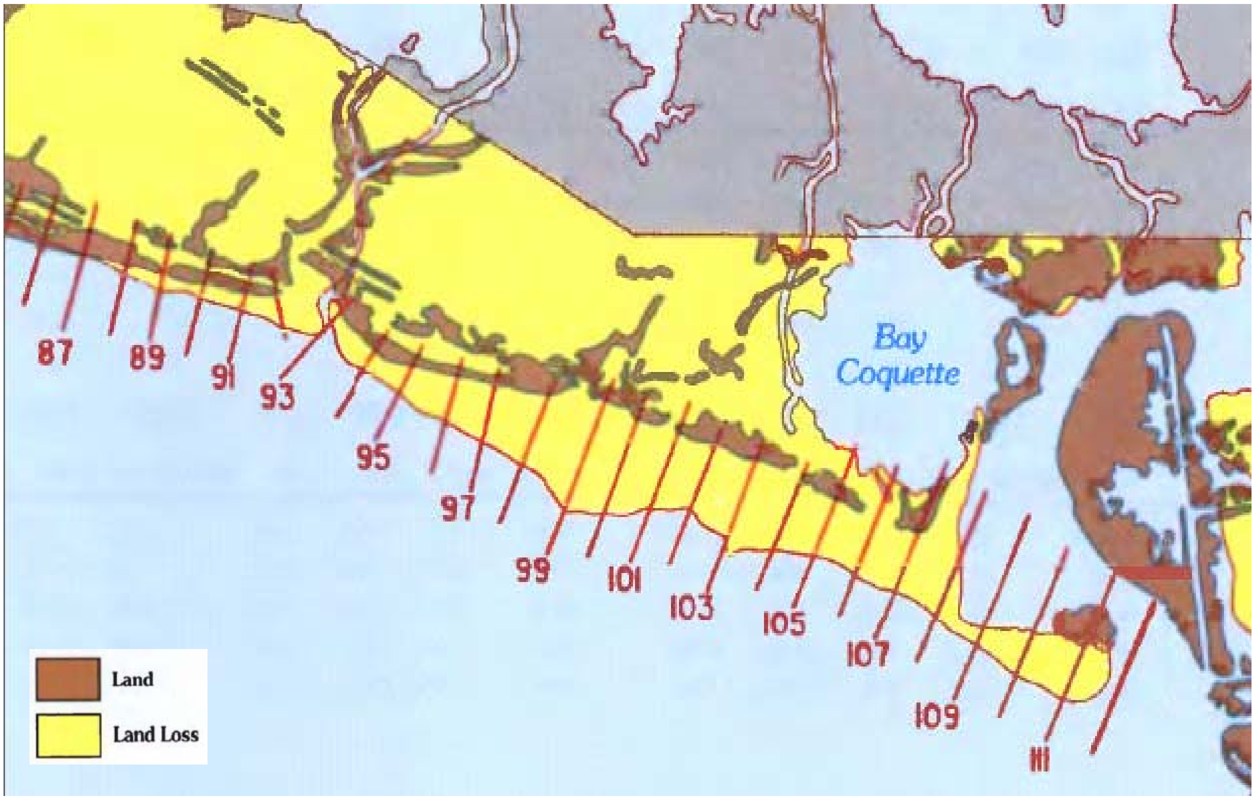


**Figure 3-1: Historic Shoreline Change Atlas, 1884 - 1988**

These changes over the 104 year time frame equated to rates of approximately (-)3.8 to (-)33.6 feet per year, with an average of approximately (-)16.5 feet per year. Figure 3-1 also portrays the significant land loss over time along Scofield Island between 1884 (yellow) and 1988 (brown).

## 3.2 Surveys

### 3.2.1 2000 Coast 2050 Survey

Morris P. Hebert, Inc. (MPH) was contracted by Louisiana Department of Natural Resources (LDNR) to conduct a topographic and bathymetric survey of five individual reaches of barrier shoreline in the Barataria Basin including the Caminada Headland, Grand Terre Islands, Chaland Headland, Scofield Island and Shell Island (LDNR, 2000).

MPH constructed five secondary control point monuments along the coast and established horizontal and vertical control of these monuments using four NGS points during a static GPS survey.

The locations of the survey transects were determined from data furnished by LDNR. On Scofield Island, MPH surveyed three lines transected perpendicular to the shoreline. The horizontal location of all transects was staked utilizing differentially corrected GPS technology to an accuracy of approximately one meter. Vertical data on land and adjacent shallow water areas was gathered utilizing conventional level equipment or centimeter level GPS technology. Transects in deeper water areas were surveyed utilizing boat-based bathymetric surveying techniques. Field work on Scofield Island was performed in late 2000.

### 3.2.2 2004 Survey

The three lines transected perpendicular to the Scofield Island shoreline and surveyed in 2000 were re-surveyed in May 2004 by GOTECH (ATM, 2004).

### 3.2.3 2008 Survey

#### 3.2.3.1 Description

Topographic and bathymetric surveys of Scofield Island were conducted in July 2008 along fifteen (15) survey lines including the short dune and marsh profiles at 1000-foot spacing and the long offshore profiles at 2000-foot spacing. Three of these lines coincided with the Coast 2050 (LDNR, 2000) survey lines acquired in the year 2000 and re-surveyed in 2004 (ATM, 2004). The long offshore survey transect lines extended from the northern boundary of the Project Restoration Area progressing south, across the existing island, and projecting a minimum of 5,800 feet seaward of the shoreline, beyond the anticipated depth of closure derived from nearby restoration projects (SJB and CEC, 2005).

#### 3.2.3.2 Methodology: Topographic Surveys

The topographic survey of Scofield Island was conducted to define the current elevations of landmasses and shallow water depth areas within the Scofield Island Restoration Area. SJB located existing monuments, field control, and ran a horizontal and vertical control network using GPS methods to establish additional monumentation and control relative to North American Datum 1983 (NAD 83) and NAVD88. Monumentation was first established on the west end of the island, another approximately one-half the distance between Empire, LA and Scofield Island, and finally near Empire, LA. The establishment of the monuments followed LDNR’s protocols established in “*A Contractor’s Guide to Minimum Standards*” (LDNR 2007) with the required observation periods and data collections.

### 3.2.3.3 Methodology: Bathymetric Surveys

The bathymetric survey was conducted using a 26-foot vessel powered by twin outboard motors, an Odom Hydrographic, Inc. Hydrotrac depth sounder with an appropriately mounted transducer, a Trimble AG135 Differential GPS, and Hypack 2008 software program used for hydrographic data collection and navigation.

All survey equipment was checked for proper operation prior to data collection. Bar checks to calibrate the fathometer with respect to transducer draft and the speed of sound through the water column were performed for verification of accuracy at the beginning of each survey day. For redundancy, two (2) YSI 600 Sondes with vented water level sensors ,were deployed off the center of Scofield Island, seaward of the beach zone, in approximately four feet of water. The purpose of the instruments was to collect tidal data for depth sounding correction with measurements being collected every ten minutes. The vertical elevation of the water level sensors was obtained utilizing an RTK-GPS referenced to the established monumentation for the Project.

Bathymetric data were collected for a minimum of 5,800 feet along the transect lines from seaward of the anticipated depth of closure to the shallowest possible depth in the nearshore area. Additional bathymetric data were collected in Scofield Pass for informational purposes and evaluation of use of Scofield Pass for construction equipment access. The bathymetry of the southern portion of Scofield Pass was measured along eleven (11) total lines; with one channel center line and ten (10) cross-channel lines originating from the mouth of the pass progressing up the channel to the northern side of Scofield Island.

### 3.2.3.4 Methodology: Data Processing

The Scofield Island wading depth and overland RTK-GPS data were processed using Leica Geo Office version 5.0. SJB compared fixed-height pole measurements against electronic data to check all rod measurements taken in the field. Where applicable, data that overlapped with the bathymetric survey data were checked for discrepancies.

Upon completion of the surveys, the bathymetric data were corrected for tidal variations and referenced to NAVD88. The bathymetric data were merged with the topographic data and reviewed for data quality. Cross-sectional views along the survey lines were developed in Hypack 2008, exported to AutoCAD, and overlaid onto the cross-sections from the 2000 and 2004 surveys.

### 3.2.3.5 Survey Plans

A plan view of the 2008 survey lines is presented in Figure 3-2. The cross-sectional views of the 2008 survey along with the 2000 and 2004 surveys are presented in Figures 3-3 through 3-6.

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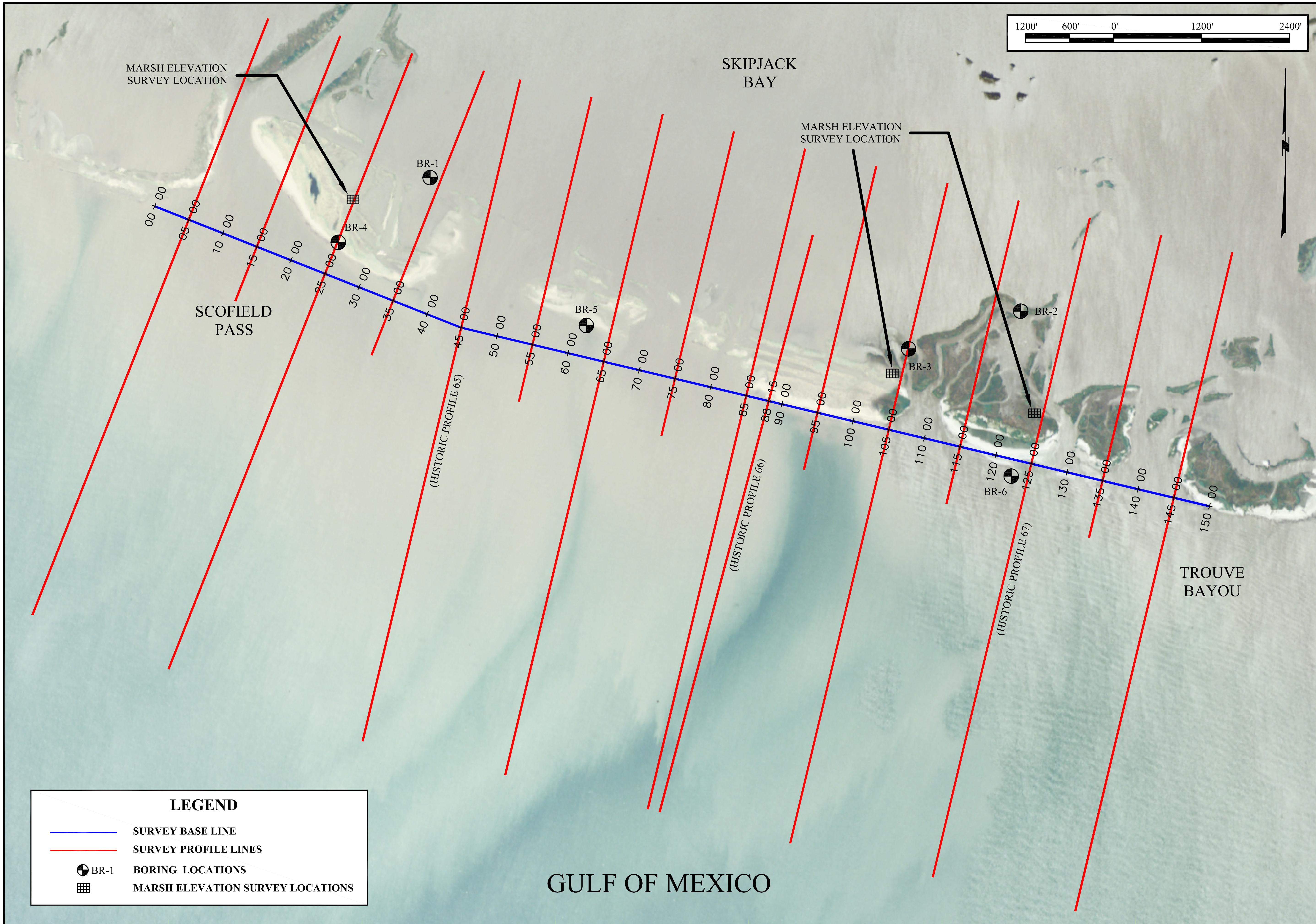



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FIGURE 3-2: SCOFIELD ISLAND SURVEY LINE LAYOUT


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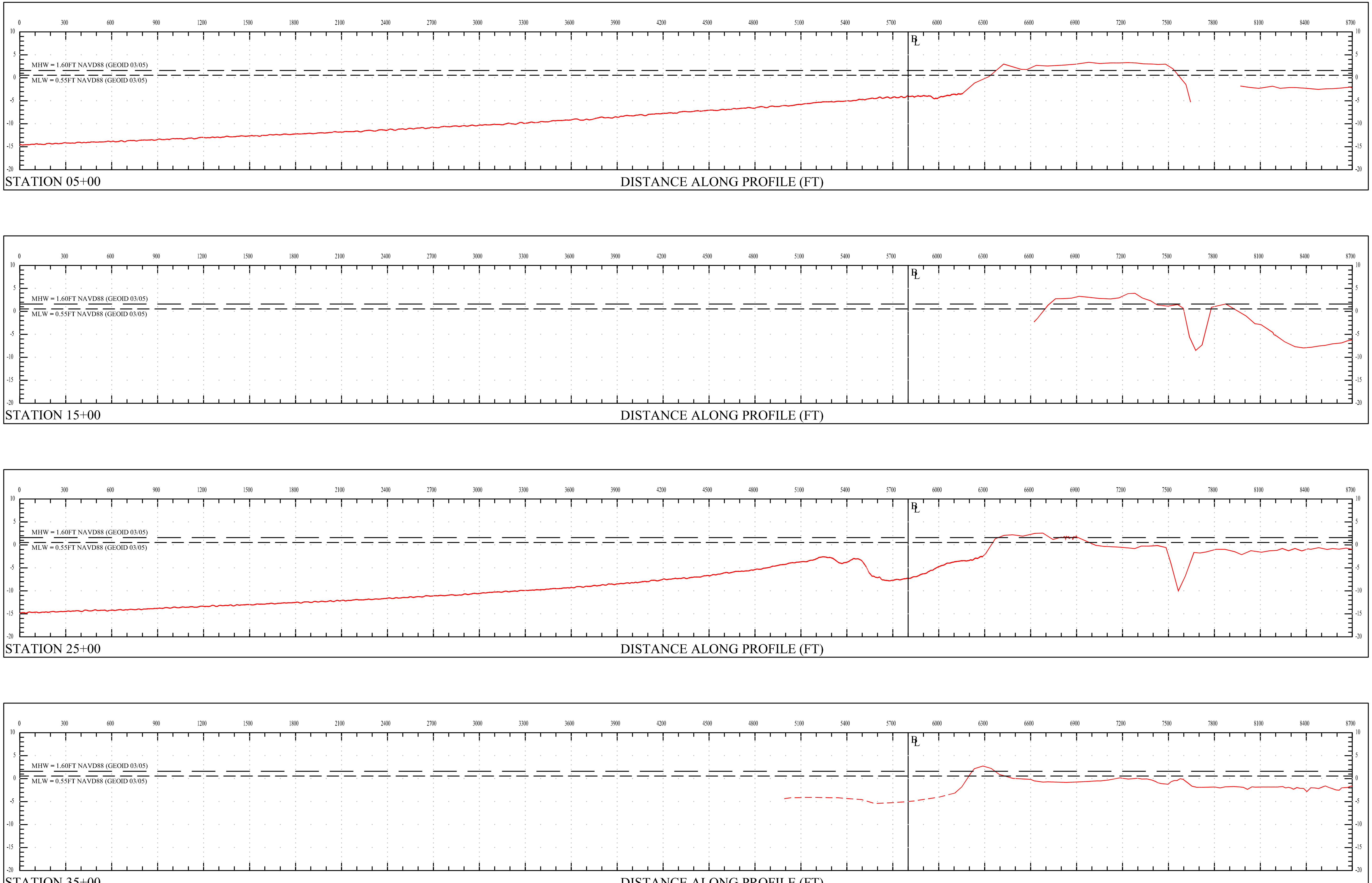
SCOFIELD ISLAND SURVEY COMPARISON DATUM
HORIZONTAL: NAD 83 STATE PLANE LA-SOUTH - FEET
VERTICAL: NAVD88 (GEOID 03/05), U.S. SURVEY FEET

2008 SURVEY    2008 INTERPOLATED SURVEY

SCALE: H: 1" = 600
V: 1" = 20'




# FIGURE 3-3: SCOFIELD ISLAND SURVEY PROFILES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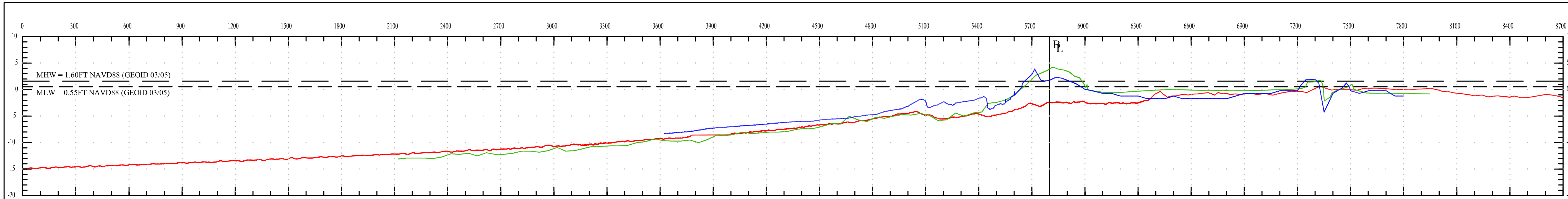
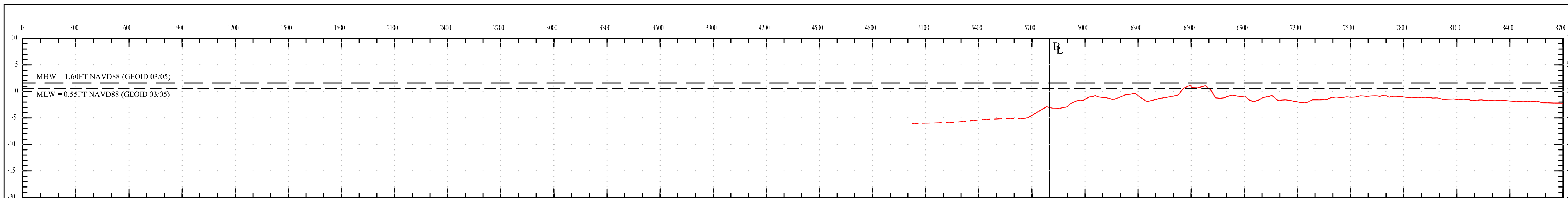
SCOFIELD ISLAND SURVEY COMPARISON DATUM
HORIZONTAL: NAD 83 STATE PLANE LA-SOUTH - FEET
VERTICAL: NAVD88 (GEOID 03/05), U.S. SURVEY FEET

2000 SURVEY — 2004 SURVEY — 2008 SURVEY — 2008 INTERPOLATED SURVEY

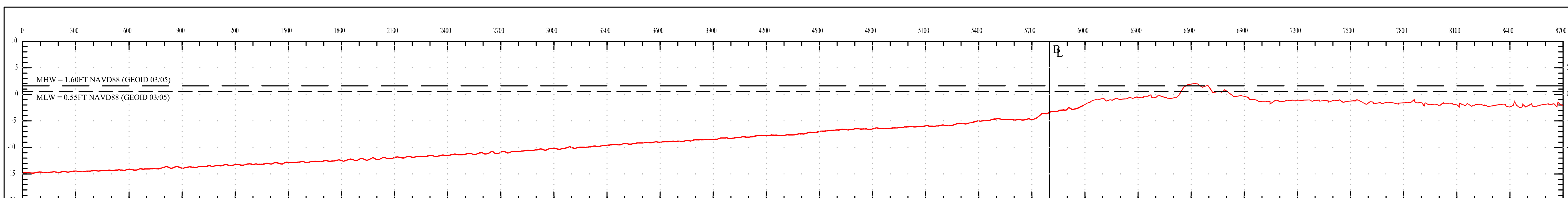
SCALE: H: 1" = 600
V: 1" = 20'



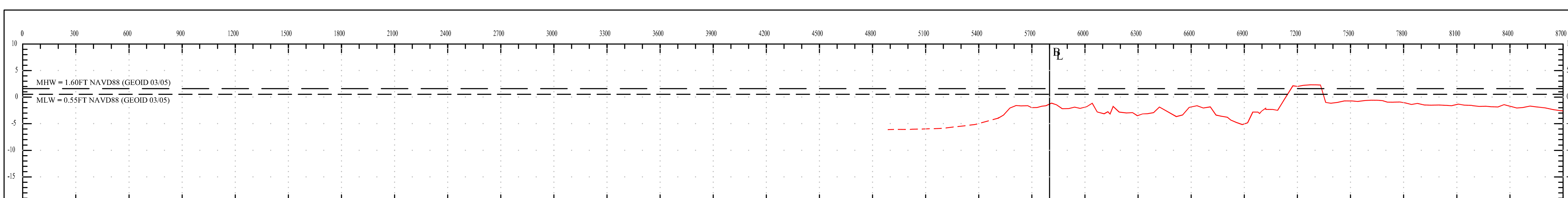
STATION 45+00 (HISTORIC PROFILE 65)



STATION 55+00



STATION 65+00



STATION 75+00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# FIGURE 3-4: SCOFIELD ISLAND SURVEY PROFILES


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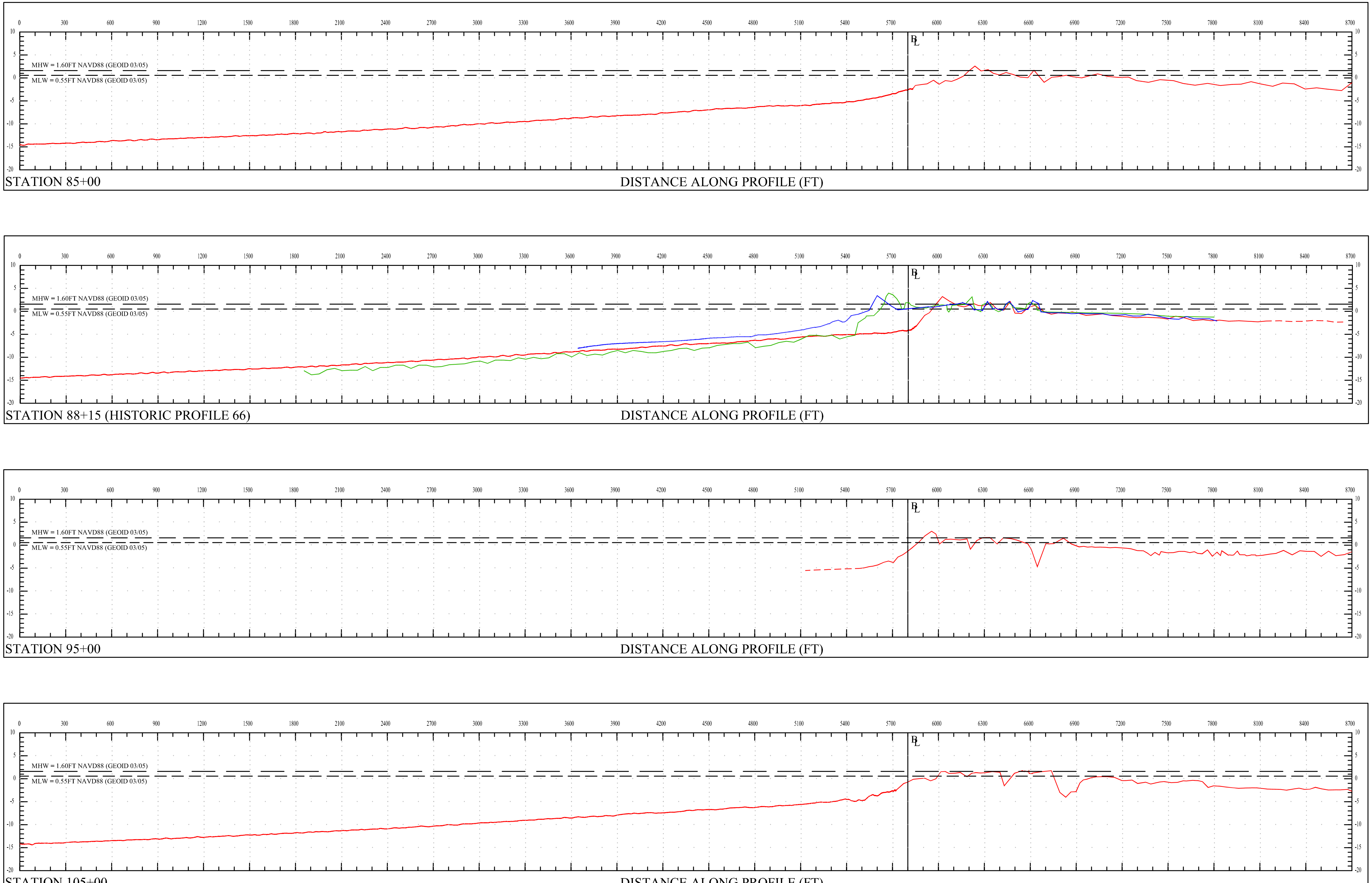
SCOFIELD ISLAND SURVEY COMPARISON DATUM
HORIZONTAL: NAD 83 STATE PLANE LA-SOUTH - FEET
VERTICAL: NAVD88 (GEOID 03/05), U.S. SURVEY FEET

2000 SURVEY — 2004 SURVEY — 2008 SURVEY — 2008 INTERPOLATED SURVEY

SCALE: H: 1" = 600
V: 1" = 20'




# FIGURE 3-5: SCOFIELD ISLAND SURVEY PROFILES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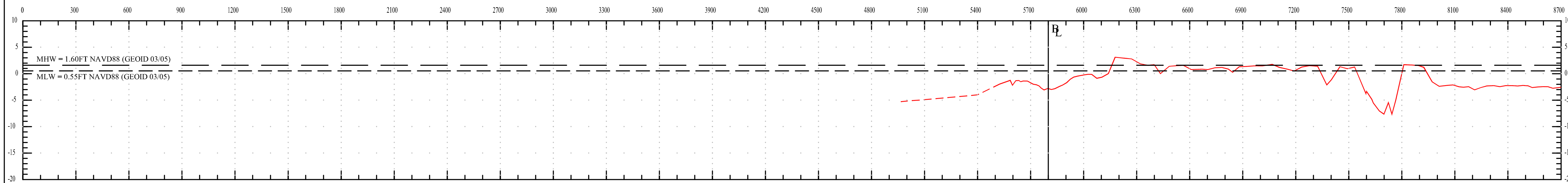
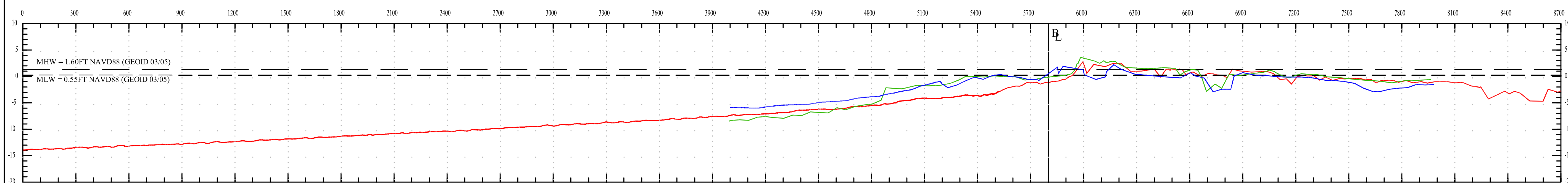
SCOFIELD ISLAND SURVEY COMPARISON DATUM
HORIZONTAL: NAD 83 STATE PLANE LA-SOUTH - FEET
VERTICAL: NAVD88 (GEOID 03/05), U.S. SURVEY FEET

2000 SURVEY — 2004 SURVEY — 2008 SURVEY — 2008 INTERPOLATED SURVEY

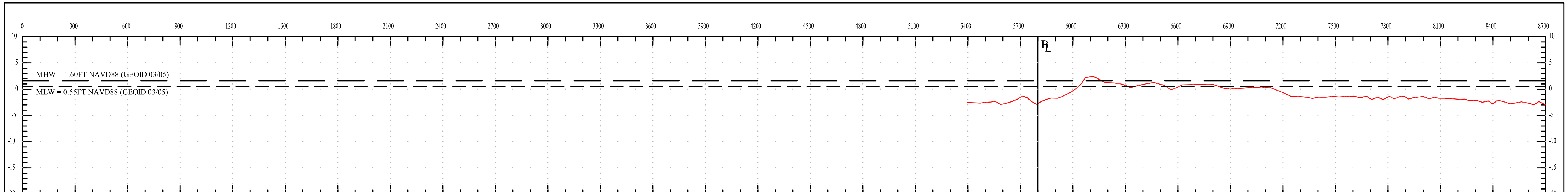
SCALE: H: 1" = 600
V: 1" = 20'




STATION 115+00 DISTANCE ALONG PROFILE (FT)




STATION 125+00 (HISTORIC PROFILE 67) DISTANCE ALONG PROFILE (FT)




STATION 135+00 DISTANCE ALONG PROFILE (FT)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# FIGURE 3-6: SCOFIELD ISLAND SURVEY PROFILES


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### 3.2.3.6 Native Marsh Elevation

The elevation for the native Scofield Island back-barrier marsh was measured during the 2008 survey at three locations (Figure 3-2) and determined to be +1.50 feet NAVD88. This was determined by taking an average of all of the elevations recorded in the proposed marsh creation area at three grids. All of the measured marsh elevations and their average are shown in Tables 3-1 to 3-3.

**Table 3-1: July 2008 Scofield Island Marsh Elevations**

| Grid Point No. | RTK Point No. | Northing, NAD83-LA-South, ft | Easting, NAD83-LA-South, ft | Elevation, ft NAVD88 |
|---|---|---|---|---|
| Grid #1 | | | | |
| 1 | 20215 | 275699.63 | 3846208.16 | 1.15 |
| 2 | 20214 | 275672.34 | 3846219.39 | 1.41 |
| 3 | 20204 | 275645.06 | 3846250.32 | 1.67 |
| 4 | 20203 | 275624.91 | 3846263.00 | 1.75 |
| 5 | 20202 | 275607.36 | 3846273.74 | 1.71 |
| 6 | 20201 | 275589.27 | 3846284.52 | 1.73 |
| 7 | 20200 | 275570.71 | 3846296.79 | 1.59 |
| 8 | 20212 | 275724.58 | 3846208.75 | 2.02 |
| 9 | 20213 | 275695.38 | 3846232.92 | 1.62 |
| 10 | 20195 | 275661.58 | 3846264.66 | 1.67 |
| 11 | 20196 | 275644.01 | 3846277.38 | 1.84 |
| 12 | 20197 | 275623.89 | 3846289.24 | 1.87 |
| 13 | 20198 | 275604.09 | 3846301.11 | 1.84 |
| 14 | 20199 | 275584.09 | 3846317.36 | 1.58 |
| 15 | 20211 | 275718.54 | 3846244.69 | 1.68 |
| 16 | 20210 | 275698.74 | 3846260.73 | 1.66 |
| 17 | 20205 | 275678.84 | 3846280.01 | 1.82 |
| 18 | 20206 | 275662.74 | 3846299.80 | 1.68 |
| 19 | 20207 | 275646.20 | 3846318.30 | 1.62 |
| 20 | 20208 | 275630.45 | 3846335.98 | 1.53 |
| 21 | 20209 | 275614.24 | 3846354.18 | 1.49 |
| | | | **Average** | **1.66** |
| Grid #2 | | | | |
| 1 | 20222 | 273353.00 | 3853468.34 | 1.76 |
| 2 | 20221 | 273343.68 | 3853498.50 | 1.77 |
| 3 | 20220 | 273330.88 | 3853520.12 | 1.44 |
| 4 | 20219 | 273325.01 | 3853545.80 | 1.61 |
| 5 | 20218 | 273323.40 | 3853575.22 | 1.63 |
| 6 | 20217 | 273322.19 | 3853603.76 | 1.54 |
| 7 | 20216 | 273318.19 | 3853630.99 | 1.70 |
| 8 | 20223 | 273378.32 | 3853478.13 | 1.67 |
| 9 | 20237 | 273368.84 | 3853510.39 | 1.52 |
| 10 | 20224 | 273369.12 | 3853535.93 | 1.45 |
| 11 | 20225 | 273361.78 | 3853569.75 | 1.48 |
| 12 | 20226 | 273356.44 | 3853598.56 | 1.54 |
| 13 | 20228 | 273348.27 | 3853625.73 | 1.71 |

| Grid Point No. | RTK Point No. | Northing, NAD83-LA-South, ft | Easting, NAD83-LA-South, ft | Elevation, ft NAVD88 |
|---|---|---|---|---|
| 14 | 20229 | 273339.15 | 3853649.74 | 1.50 |
| 15 | 20236 | 273415.76 | 3853477.32 | 1.27 |
| 16 | 20235 | 273407.20 | 3853504.73 | 1.26 |
| 17 | 20234 | 273398.42 | 3853533.64 | 1.29 |
| 18 | 20233 | 273392.97 | 3853562.22 | 1.29 |
| 19 | 20232 | 273385.69 | 3853591.32 | 1.43 |
| 20 | 20231 | 273375.12 | 3853618.74 | 1.24 |
| 21 | 20230 | 273368.85 | 3853644.42 | 1.13 |
| | | | **Average** | **1.49** |
| | | Grid #3 | | |
| 1 | 20244 | 272792.03 | 3855491.61 | 1.42 |
| 2 | 20243 | 272795.98 | 3855517.45 | 1.34 |
| 3 | 20242 | 272789.11 | 3855543.64 | 1.19 |
| 4 | 20241 | 272778.65 | 3855569.07 | 1.18 |
| 5 | 20240 | 272765.54 | 3855594.32 | 1.39 |
| 6 | 20239 | 272752.58 | 3855619.46 | 1.37 |
| 7 | 20238 | 272737.50 | 3855645.09 | 1.27 |
| 8 | 20245 | 272817.75 | 3855483.35 | 1.54 |
| 9 | 20246 | 272821.73 | 3855510.78 | 1.55 |
| 10 | 20247 | 272816.26 | 3855538.66 | 1.40 |
| 11 | 20248 | 272804.84 | 3855563.88 | 1.36 |
| 12 | 20249 | 272795.38 | 3855589.13 | 1.32 |
| 13 | 20250 | 272785.18 | 3855612.85 | 1.38 |
| 14 | 20251 | 272770.25 | 3855638.85 | 1.40 |
| 15 | 20252 | 272765.94 | 3855661.83 | 1.42 |
| 16 | 20259 | 272869.25 | 3855518.11 | 1.45 |
| 17 | 20258 | 272856.96 | 3855544.13 | 1.34 |
| 18 | 20257 | 272843.31 | 3855568.26 | 1.29 |
| 19 | 20255 | 272830.09 | 3855591.05 | 1.38 |
| 20 | 20254 | 272818.72 | 3855615.79 | 1.23 |
| 21 | 20256 | 272802.48 | 3855644.75 | 1.34 |
| 22 | 20253 | 272790.00 | 3855664.93 | 1.25 |
| | | | **Average** | **1.36** |

| | |
|---|---|
| **Island Average Marsh Elevation** | **1.50** |

### 3.3 Survey Comparisons

#### 3.3.1 Shoreline Changes

Based on the survey comparisons, the changes in shoreline position at Mean High Water (MHW), +1.60 feet NAVD88, were computed for three time periods including 2000-2004, 2004-2008, and 2000-2008 and are presented in Tables 3-2 through 3-4, respectively. Between 2000 and 2004, the erosion rates at MHW range from approximately 8 to 27 feet per year with an average of approximately 18 feet per year. Between 2004 and 2008, the erosion rates at MHW increased ranging from approximately 5 to 200 feet per year with an average of approximately 106 feet per year. The overall erosion rates at MHW between 2000 and 2008 ranged from approximately 16 to 79 feet per year with an average of approximately 49 feet per year. As previously stated in Section 3.1, the average long-term erosion rate is approximately 16.5 feet per year.

**Table 3-2: 2000 to 2004 Shoreline Changes at MHW**

| **Mean High Water (+1.60 feet NAVD88)** | | | | |
|---|---|---|---|---|
| Profile (2008 Station) | Distance from Baseline - Coast 2050 Survey (ft) | Distance from Baseline - 2004 Survey (ft) | Shoreline Change (ft) | Shoreline Change Rate (ft/yr) |
| 65 (45+00) | 141.3 | 110.2 | -31.1 | -7.8 |
| 66 (88+15) | 233.2 | 159.6 | -73.6 | -18.4 |
| 67 (125+00) | -45.3 | -155.0 | -109.7 | -27.4 |
| | | **Average** | **-71.5** | **-17.9** |

**Table 3-3: 2004 to 2008 Shoreline Changes at MHW**

| **Mean High Water (+1.60 feet NAVD88)** | | | | |
|---|---|---|---|---|
| Profile (2008 Station) | Distance from Baseline - 2004 Survey (ft) | Distance from Baseline - 2008 Survey (ft) | Shoreline Change (ft) | Shoreline Change Rate (ft/yr) |
| 65* (45+00) | 110.2 | -490.3 | -600.5 | -200.2 |
| 66 (88+15) | 159.6 | -182.5 | -342.1 | -114.0 |
| 67 (125+00) | -155.0 | -169.3 | -14.3 | -4.8 |
| | | **Average** | **-319.0** | **-106.3** |

*Breach at Profile 65 in 2005, 2008 based on interpolated shoreline

**Table 3-4: 2000 to 2008 Shoreline Changes at MHW**

| Mean High Water (+1.60 feet NAVD88) | | | | |
|---|---|---|---|---|
| Profile (2008 Station) | Distance from Baseline - Coast 2050 Survey (ft) | Distance from Baseline - 2008 Survey (ft) | Shoreline Change (ft) | Shoreline Change Rate (ft/yr) |
| 65 (45+00) | 141.3 | -490.3 | -631.6 | -79.0 |
| 66 (88+15) | 233.2 | -182.5 | -415.7 | -52.0 |
| 67 (125+00) | -45.3 | -169.3 | -124.0 | -15.5 |
| | | **Average** | **-390.4** | **-48.8** |

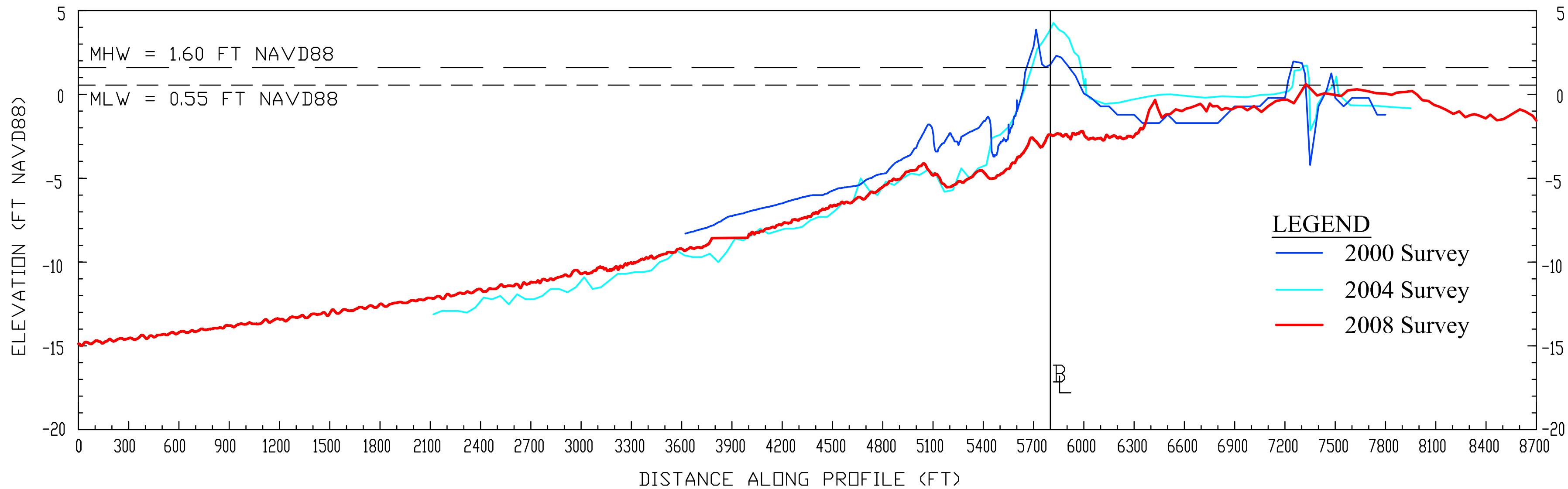
*Breach at Profile 65 in 2005, 2008 based on interpolated shoreline

### 3.3.2 Volume Changes

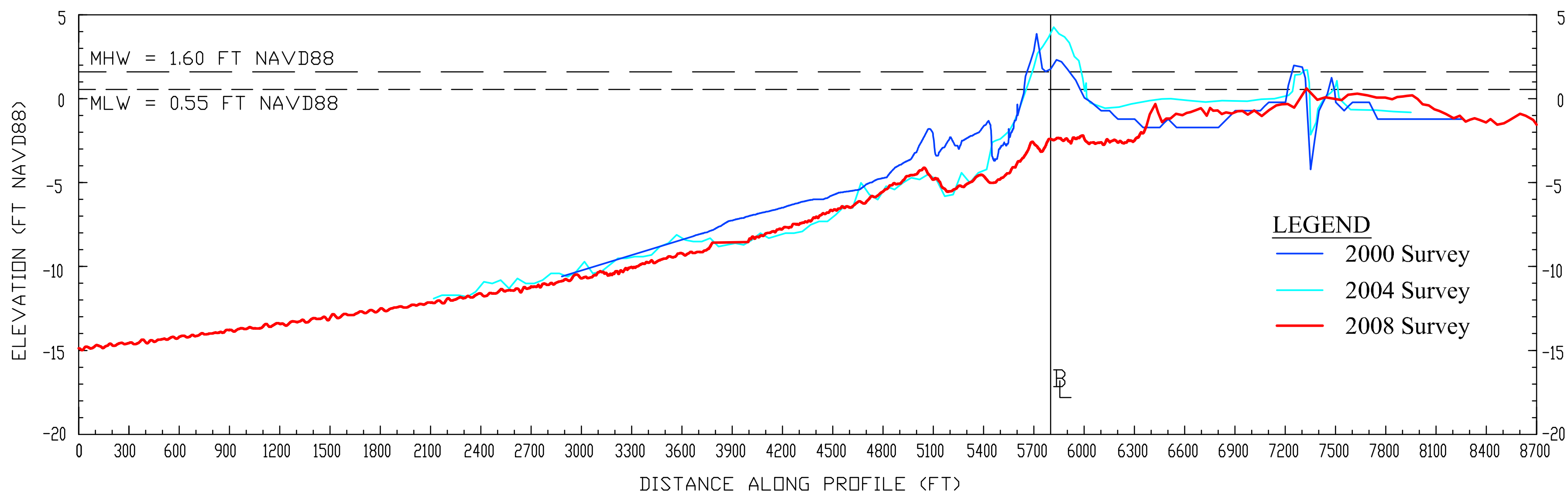
Upon reviewing the historical profile comparisons it was noted that for the majority of the profiles, the offshore portions for any given survey year neither overlapped nor closed with another year, indicating vertical inaccuracies in the historical data. To address the inaccuracies, the following method was employed using CADD. The historical data files containing the profile information were used to determine the last upland point collected and first offshore point collected. The 2000 and 2004 profiles were trimmed between these two points. Next, the offshore portions of the 2000 and 2004 profiles were adjusted vertically to overlap the 2008 profiles, while the upland portions remained the same. Finally, the offshore portions of the 2000 and 2004 profiles were reconnected with straight lines to the upland portions. Figures 3-7 through 3-9 present comparisons between the original and adjusted profiles for the three transects.

45+00 (PROFILE 65) - UNCORRECTED

SCALE: Horz: 1" = 1000', Vert: 1" = 10'




45+00 (PROFILE 65) - CORRECTED (VERTICAL CORRECTION = 1.2 FT)





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LOUISIANA DEPARTMENT OF NATURAL RESOURCES

RIVERINE SAND MINING / SCOFIELD ISLAND RESTORATION (BA-40)

FIGURE 3-7

| | |
|---|---|
| DATE: FEB 19, 2009 | SHEET: 1 OF 3 |
| DESIGNED: | DRAWN: S.D.O. |
| CHECKED: M.T.P. | SCALE: AS NOTED |
| STATE PROJECT NUMBER: BA-40 | |
| FEDERAL PROJECT NUMBER: BA-40 | |
| APPROVED BY: | |

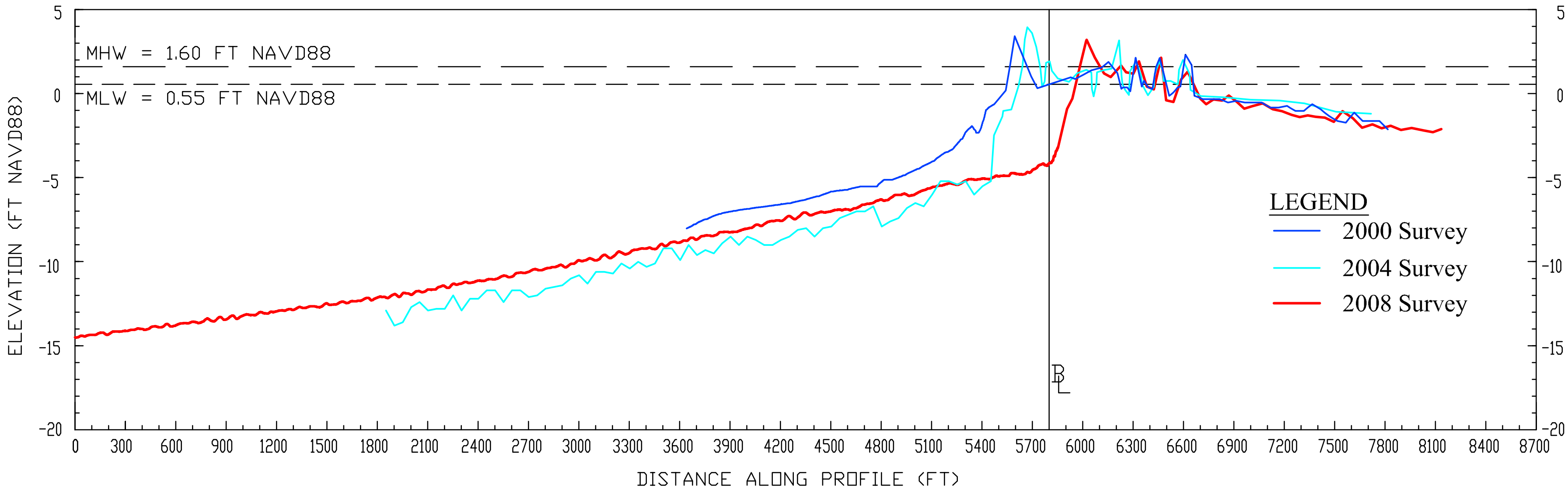
FILE: Scofield-Survey-xsect-vertical-correction.dwg

| REV. | DATE | BY | DESCRIPTION |
|---|---|---|---|

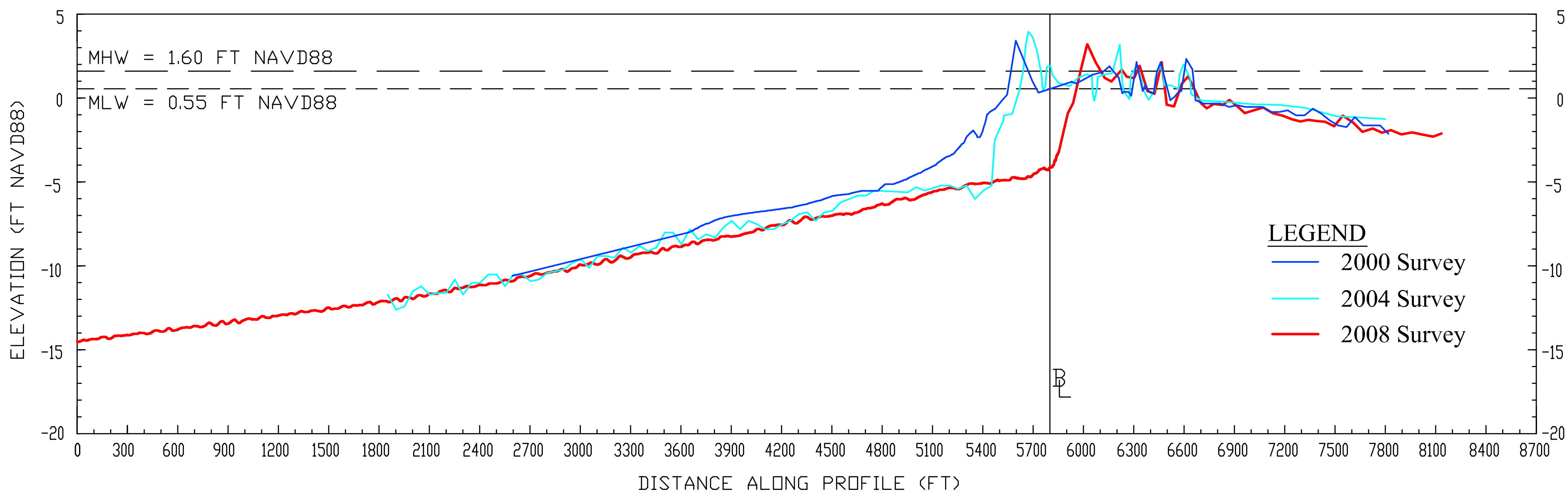
SHEET: 1

88+15 (PROFILE 66) - UNCORRECTED

SCALE: Horz: 1" = 1000', Vert: 1" = 10'




88+15 (PROFILE 66) - CORRECTED (VERTICAL CORRECTION = 1.2 FT)





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LOUISIANA DEPARTMENT OF NATURAL RESOURCES

RIVERINE SAND MINING / SCOFIELD ISLAND RESTORATION (BA-40)

FIGURE 3-8

| | |
|---|---|
| DATE: FEB 19, 2009 | SHEET: 2 OF 3 |
| DESIGNED: | DRAWN: S.D.O. |
| CHECKED: M.T.P. | SCALE: AS NOTED |
| STATE PROJECT NUMBER: BA-40 | |
| FEDERAL PROJECT NUMBER: BA-40 | |
| APPROVED BY: | |

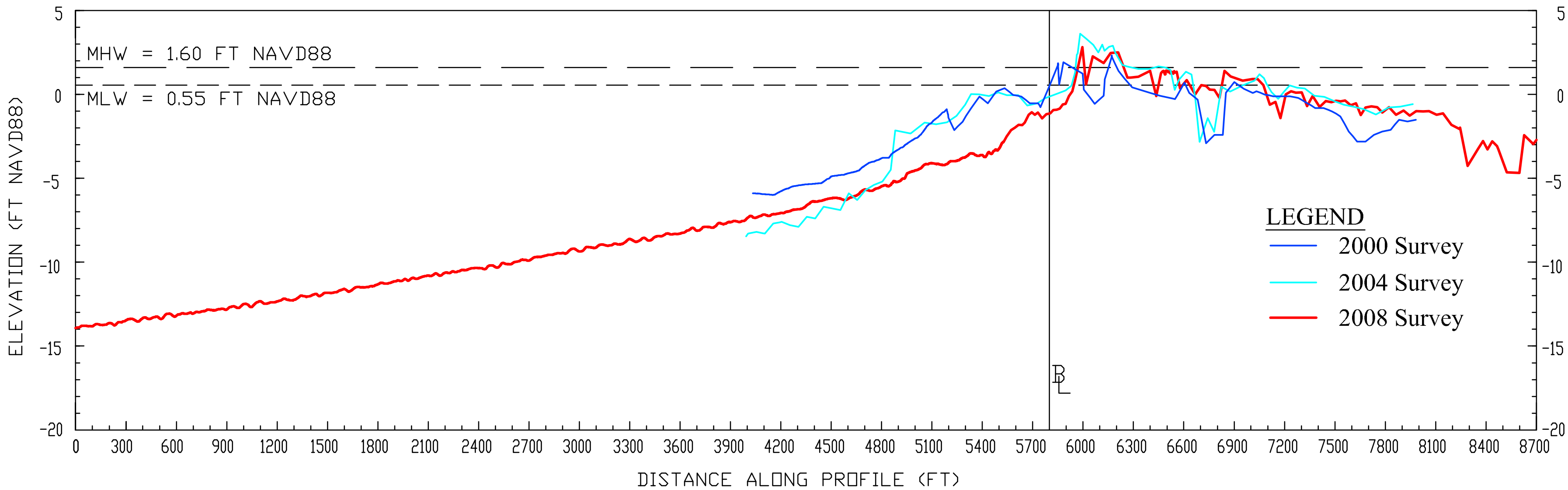
FILE: Scofield-Survey-xsect-vertical-correction.dwg

| REV. | DATE | BY | DESCRIPTION |
|---|---|---|---|

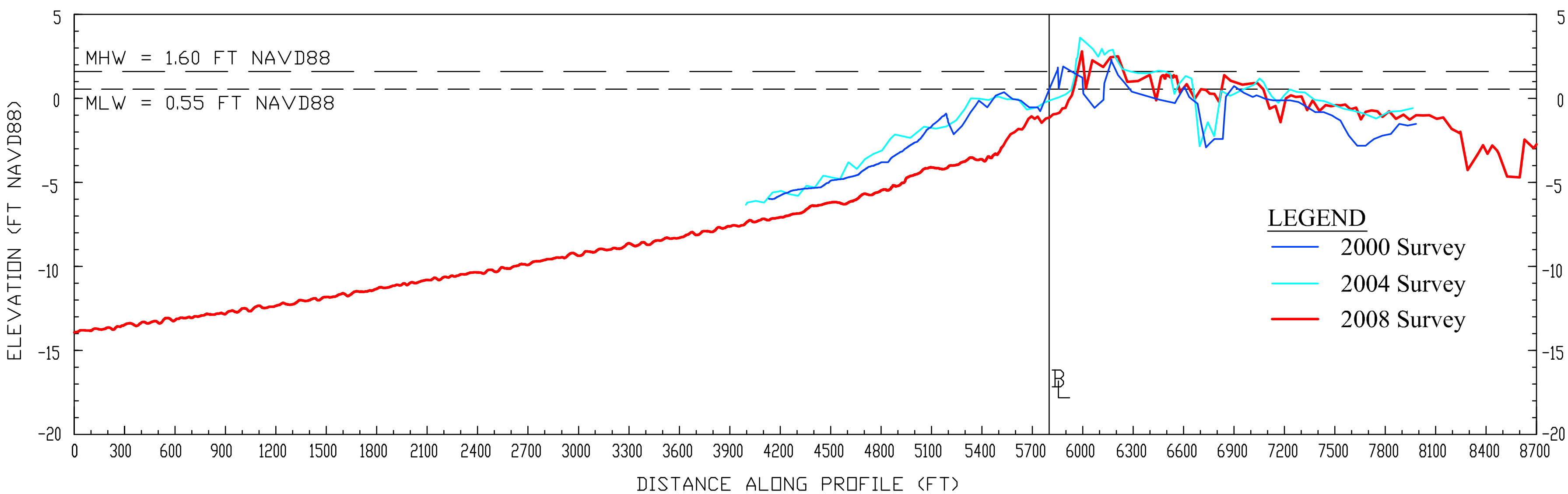
SHEET: 2

125+00 (PROFILE 67) - UNCORRECTED

SCALE: Horz: 1" = 1000', Vert: 1" = 10'




125+00 (PROFILE 67) - CORRECTED (VERTICAL CORRECTION = 2.1 FT)

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LOUISIANA DEPARTMENT OF NATURAL RESOURCES
RIVERINE SAND MINING / SCOFIELD ISLAND RESTORATION (BA-40)

FIGURE 3-9

| | |
|---|---|
| DATE: FEB 19, 2009 | SHEET: 3 OF 3 |
| DESIGNED: | DRAWN: S.D.O. |
| CHECKED: M.T.P. | SCALE: AS NOTED |
| STATE PROJECT NUMBER: BA-40 | |
| FEDERAL PROJECT NUMBER: BA-40 | |
| APPROVED BY: | |

FILE: Scofield-Survey-xsect-vertical-correction.dwg

| REV. | DATE | BY | DESCRIPTION |
|---|---|---|---|

SHEET: 3

Comparisons between the 2000, 2004, and 2008 surveys were analyzed to compute the volumetric changes along Scofield Island. As presented in Table 3-5, between 2000 and 2004, the cumulative volume change equals approximately (-)42,000 cubic yards per year. The gulf-side volume change for the same time period equals approximately (-)135,500 cubic yards per year (Table 3-6).

**Table 3-5: 2000-2004 Cumulative Volume Changes**

| PROFILE STATION (2008) | TRANSECT | CELL AREA ($YD^3$/FT) | AVERAGE CELL AREA (YD3/FT) | LENGTH (FT) | VOLUME ($YD^3$) |
|---|---|---|---|---|---|
| | Western End | 0.00 | | | |
| | | | -13.39 | 2,257 | -30,217 |
| 45+00 | 65 | -26.77 | | | |
| | | | -33.24 | 4,315 | -143,423 |
| 88+15 | 66 | -39.70 | | | |
| | | | -31.65 | 3,685 | -116,628 |
| 125+00 | 67 | -23.60 | | | |
| | | | -11.80 | 1,366 | -16,116 |
| | East End | 0.00 | | | |
| | | | | TOTAL | -167,587 |
| | | | | CHANGE/YR | -41,897 |

**Table 3-6: 2000-2004 Gulf-side Volume Changes**

| PROFILE STATION (2008) | TRANSECT | CELL AREA ($YD^3$/FT) | AVERAGE CELL AREA (YD3/FT) | LENGTH (FT) | VOLUME ($YD^3$) |
|---|---|---|---|---|---|
| | Western End | 0.00 | | | |
| | | | -42.34 | 2,257 | -95,577 |
| 45+00 | 65 | -84.68 | | | |
| | | | -84.86 | 4,315 | -366,175 |
| 88+15 | 66 | -85.04 | | | |
| | | | -25.84 | 3,685 | -95,214 |
| 125+00 | 67 | 33.36 | | | |
| | | | 16.68 | 1,366 | 22,785 |
| | East End | 0.00 | | | |
| | | | | TOTAL | -534,180 |
| | | | | CHANGE/YR | -133,545 |

As presented in Table 3-7, between 2004 and 2008 the cumulative volume change along Scofield Island increased to approximately (-)364,400 cubic yards per year. The gulf-side volume change for the same time period equals approximately (-)335,200 cubic yards per year (Table 3-8), which is 147% more than that of the 2000-2004 period. This significant increase is attributed to the hurricanes affecting Scofield Island in 2005 (Hurricanes Katrina and Rita) resulting in major island breaches.

**Table 3-7: 2004-2008 Cumulative Volume Changes**

| PROFILE STATION (2008) | TRANSECT | CELL AREA ($YD^3/FT$) | AVERAGE CELL AREA (YD3/FT) | LENGTH (FT) | VOLUME ($YD^3$) |
|---|---|---|---|---|---|
| | Western End | 0.00 | | | |
| | | | -72.28 | 2,257 | -163,167 |
| 45+00 | 65 | -144.56 | | | |
| | | | -139.03 | 4,315 | -599,942 |
| 88+15 | 66 | -133.50 | | | |
| | | | -155.53 | 3,685 | -573,124 |
| 125+00 | 67 | -177.56 | | | |
| | | | -88.78 | 1,366 | -121,271 |
| | East End | 0.00 | | | |
| | | | | TOTAL | -1,457,505 |
| | | | | CHANGE/YR | -364,376 |

**Table 3-8: 2004-2008 Gulf-side Volume Changes**

| PROFILE STATION (2008) | TRANSECT | CELL AREA ($YD^3/FT$) | AVERAGE CELL AREA (YD3/FT) | LENGTH (FT) | VOLUME ($YD^3$) |
|---|---|---|---|---|---|
| | Western End | 0.00 | | | |
| | | | -68.04 | 2,257 | -153,599 |
| 45+00 | 65 | -136.09 | | | |
| | | | -123.43 | 4,315 | -532,603 |
| 88+15 | 66 | -110.77 | | | |
| | | | -144.54 | 3,685 | -532,642 |
| 125+00 | 67 | -178.32 | | | |
| | | | -89.16 | 1,366 | -121,792 |
| | East End | 0.00 | | | |
| | | | | TOTAL | -1,340,637 |
| | | | | CHANGE/YR | -335,159 |

Overall, between 2000 and 2008, the cumulative volume change along Scofield Island presented in Table 3-9, equals approximately (-)203,200 cubic yards per year. The gulf-side volume change for the same time period equals approximately (-)229,600 cubic yards per year (Table 3-10).

**Table 3-9: 2000-2008 Cumulative Volume Changes**

| PROFILE STATION (2008) | TRANSECT | CELL AREA ($YD^3/FT$) | AVERAGE CELL AREA (YD3/FT) | LENGTH (FT) | VOLUME ($YD^3$) |
|---|---|---|---|---|---|
| | Western End | 0.00 | | | |
| | | | -89.32 | 2,257 | -201,639 |
| 45+00 | 65 | -178.65 | | | |
| | | | -190.90 | 4,315 | -823,765 |
| 88+15 | 66 | -203.15 | | | |
| | | | -146.37 | 3,685 | -539,371 |
| 125+00 | 67 | -89.58 | | | |
| | | | -44.79 | 1,366 | -61,186 |
| | East End | 0.00 | | | |
| | | | | TOTAL | -1,625,960 |
| | | | | CHANGE/YR | -203,245 |

**Table 3-10: 2000-2008 Gulf-side Volume Changes**

| PROFILE STATION (2008) | TRANSECT | CELL AREA ($YD^3/FT$) | AVERAGE CELL AREA (YD3/FT) | LENGTH (FT) | VOLUME ($YD^3$) |
|---|---|---|---|---|---|
| | Western End | 0.00 | | | |
| | | | -104.43 | 2,257 | -235,728 |
| 45+00 | 65 | -208.85 | | | |
| | | | -201.96 | 4,315 | -871,470 |
| 88+15 | 66 | -195.06 | | | |
| | | | -170.79 | 3,685 | -629,348 |
| 125+00 | 67 | -146.51 | | | |
| | | | -73.25 | 1,366 | -100,066 |
| | East End | 0.00 | | | |
| | | | | TOTAL | -1,836,611 |
| | | | | CHANGE/YR | -229,576 |

## 4.0 COASTAL PROCESSES

### 4.1 Introduction

The Wave Information Studies (WIS) database was utilized to analyze wind and wave conditions specific to the Scofield Island area. WIS project (Hubertz, 1992) produced a high-quality online database of hindcast, nearshore wave conditions covering U.S. coastlines (http://chl.erdc.usace.army.mil/). The data cover a 20-year period, from January 1, 1980 through December 31, 1999. The time interval for data acquisition was one hour. Figure 4-1 presents a location map of WIS stations off the coast of Louisiana.

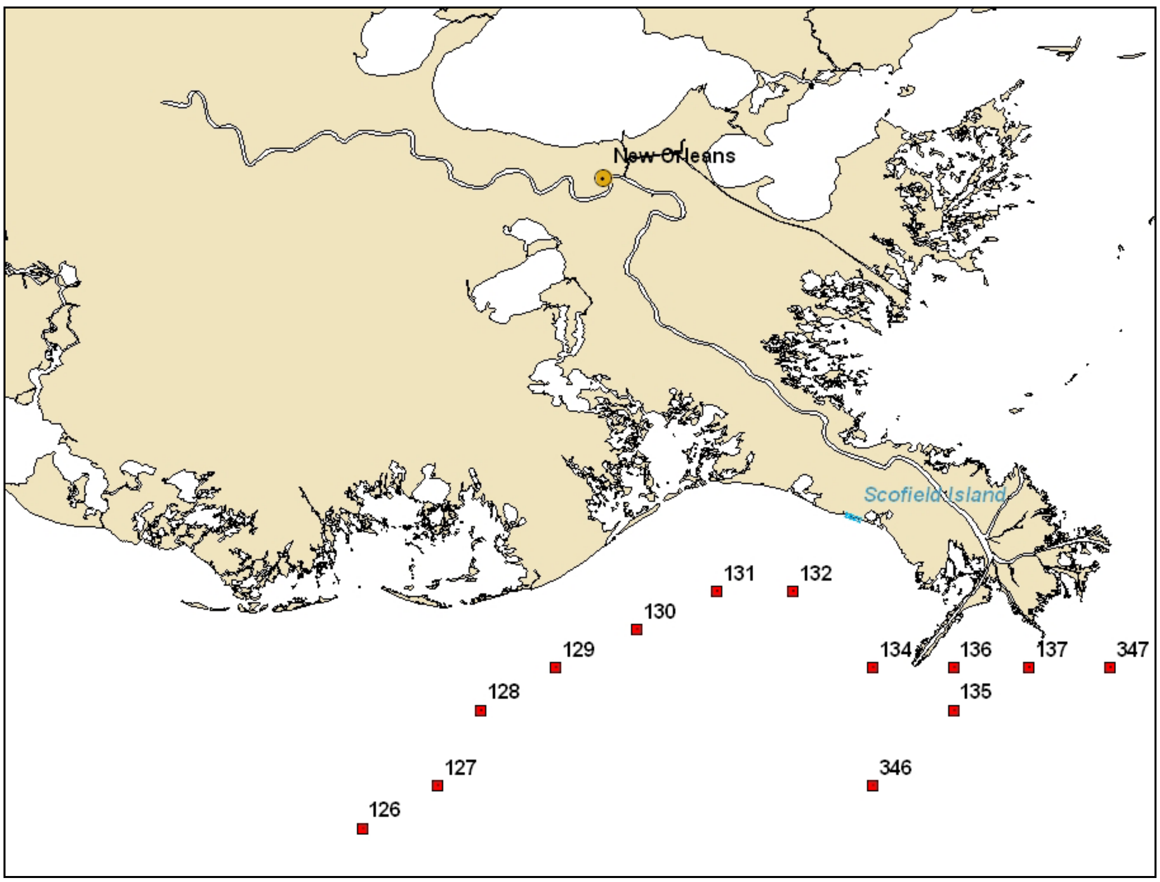


**Figure 4-1: WIS Station Location Map**

WIS data used in the analysis were obtained at Station 132 (WIS-132) located in 62 feet water depth at (LAT=29.08N, LON=89.67W), approximately 13 miles seaward of Scofield Island.

## 4.2 Winds

Figure 4-2 and Table 4-1 present a wind rose and directional wind statistics based on the 20-year period.

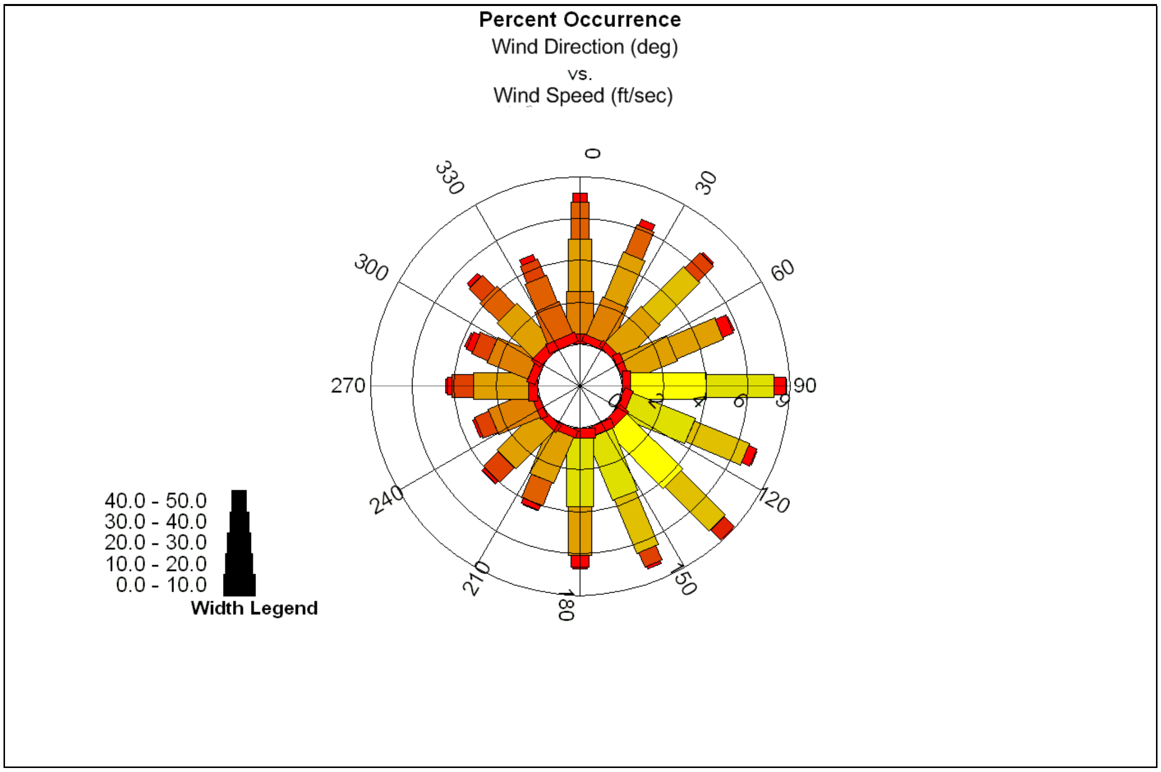


**Figure 4-2: Wind Rose at WIS Station 132**

**Table 4-1: Directional Wind Statistics**

| ANGLE BAND | AVERAGE WIND SPEED (MPH) | % OCCURRENCE |
|---|---|---|
| 348.75 - 11.24 | 16.9 | 7.8 |
| 11.25 - 33.74 | 16.3 | 6.9 |
| 33.75 - 56.24 | 15.2 | 7.2 |
| 56.25 - 78.74 | 14.1 | 6.2 |
| 78.75 - 101.24 | 13.6 | 8.5 |
| 101.25 - 123.74 | 13.5 | 7.5 |
| 123.75 - 146.24 | 13.7 | 8.6 |
| 146.25 - 168.74 | 14.1 | 7.9 |
| 168.75 - 191.24 | 13.4 | 7.2 |
| 191.25 - 213.74 | 12.3 | 4.6 |
| 213.75 - 236.24 | 11.8 | 4.5 |
| 236.25 - 258.74 | 11.6 | 3.6 |
| 258.75 - 281.24 | 12.1 | 4.7 |
| 281.25 - 303.74 | 12.7 | 4.1 |
| 303.75 - 326.24 | 14.5 | 5.7 |
| 326.25 - 348.74 | 15.4 | 5.0 |

## 4.3 Waves

Wave data statistics from 1980 to 1999 were also generated using WIS Station 132. Figure 4-3 presents a wave rose based on the 20-year period. Directional and seasonal wave statistics are presented in Tables 4-2 and 4-3, respectively. The mean significant wave height, period and dominant wave direction for all the waves were approximately 2.7 feet, 4 seconds, and 157.5 degrees, respectively. The average shoreline orientation from west to east is 108 degrees, thus the angle band of onshore waves is 108 to 288 degrees.

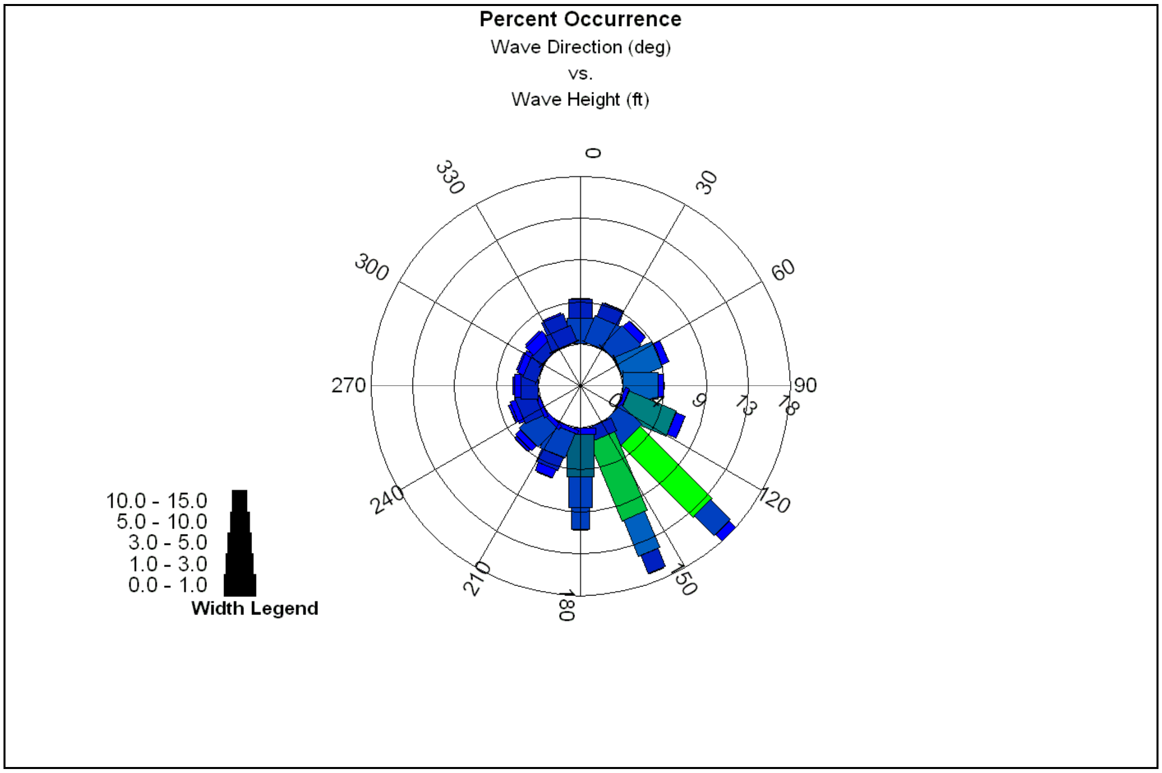


**Figure 4-3: Wave Rose at WIS Station 132**

**Table 4-2: Directional Wave Statistics**

| ANGLE BAND (DEG) | AVG. WAVE HEIGHT (FT) | % OCCURRENCE | AVG. PERIOD (SEC) |
|---|---|---|---|
| 348.75 - 11.24 | 2.9 | 4.8 | 3.8 |
| 11.25 - 33.74 | 2.6 | 4.6 | 3.7 |
| 33.75 - 56.24 | 2.4 | 4.1 | 3.6 |
| 56.25 - 78.74 | 2.3 | 5.1 | 3.5 |
| 78.75 - 101.24 | 2.2 | 4.3 | 3.5 |
| 101.25 - 123.74 | 2.2 | 7.0 | 3.5 |
| 123.75 - 146.24 | 2.2 | 17.7 | 4.1 |
| 146.25 - 168.74 | 3.0 | 16.7 | 4.6 |
| 168.75 - 191.24 | 3.6 | 10.8 | 4.9 |
| 191.25 - 213.74 | 3.2 | 5.7 | 4.6 |
| 213.75 - 236.24 | 2.4 | 4.4 | 4.1 |
| 236.25 - 258.74 | 2.6 | 3.4 | 4.0 |
| 258.75 - 281.24 | 2.8 | 2.7 | 3.9 |
| 281.25 - 303.74 | 2.8 | 2.4 | 3.8 |
| 303.75 - 326.24 | 3.0 | 2.7 | 3.9 |
| 326.25 - 348.74 | 2.9 | 3.5 | 3.8 |

**Table 4-3: Offshore Wave Statistics-From WIS Generated Tables for Station 132**

| MONTH | WAVE HEIGHT (FT) | | PERIOD* (SEC) | DIRECTION* (DEG) |
|---|---|---|---|---|
| | AVG. | MAX | | |
| Jan. | 3.2 | 15.4 | 11 | 176 |
| Feb. | 3.3 | 12.5 | 9 | 169 |
| March | 3.3 | 12.8 | 11 | 170 |
| April | 3.1 | 11.5 | 10 | 258 |
| May | 2.5 | 9.8 | 9 | 185 |
| June | 2.2 | 8.2 | 7 | 211 |
| July | 1.9 | 14.4 | 9 | 185 |
| Aug. | 1.7 | 17.4 | 11 | 165 |
| Sept. | 2.2 | 14.8 | 10 | 140 |
| Oct. | 2.6 | 25.3 | 14 | 167 |
| Nov. | 3.1 | 13.1 | 9 | 170 |
| Dec. | 3.2 | 11.8 | 9 | 176 |
| **Overall** | **2.7** | **25.3** | **14** | **167** |

*period and direction associated with MAX wave height

Figure 4-4 presents extremal wave height distribution based on which wave parameters associated with various return periods were determined. These parameters are presented in Table 4-4.

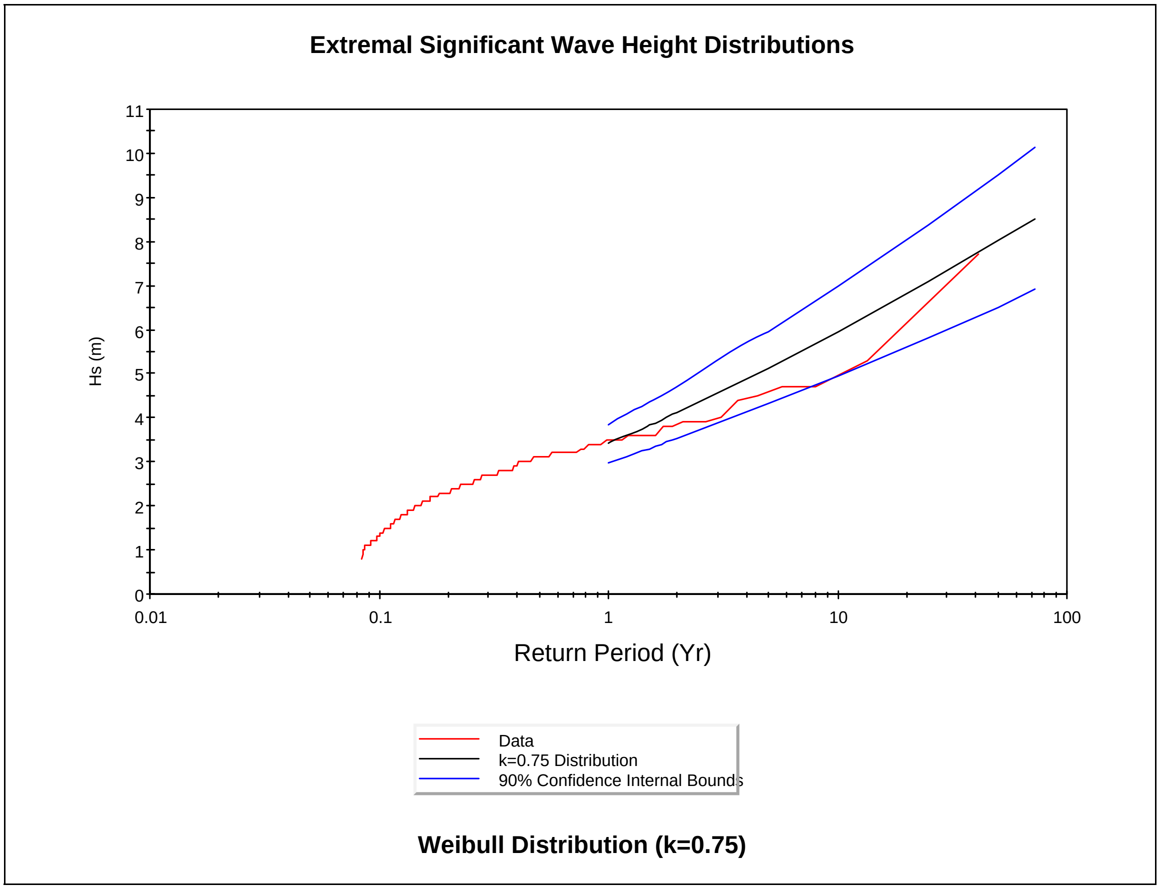


**Figure 4-4: Extremal Wave Height Distribution at WIS Station 132**

**Table 4-4: Extremal Wave Parameters vs. Return Period for Station 132**

| RETURN PERIOD (YEARS) | WAVE HEIGHT (FT) | WAVE PERIOD (SEC) | PROBABILITY * | PROBABILITY** |
|---|---|---|---|---|
| 1 | 8.9 | 8.0 | 1.0 | 1.000 |
| 2 | 13.5 | 9.3 | 0.5 | 0.750 |
| 5 | 16.9 | 10.4 | 0.2 | 0.672 |
| 10 | 19.6 | 11.2 | 0.1 | 0.651 |
| 20 | 22.5 | 12.0 | 0.05 | 0.641 |
| 50 | 26.3 | 13.0 | 0.02 | 0.636 |
| 100 | 29.4 | 13.8 | 0.01 | 0.634 |

* indicates the probability of the event occurring in any given year
(e.g., the probability of a 20-year storm occurring in 2009 is 0.05 or 5% chance)
** indicated the probability of the event occurring during the corresponding return period
(e.g., the probability of a 10-year storm occurring during 2009-2018 is 0.651 or 65.1% chance)

## 4.4 Tides

The tidal datum at Grand Isle is presented in Table 4-5. The tidal datum is based on a five year record from January 1990 through December 1994. The tidal epoch is 1960 – 1978 (NOAA).

**Table 4-5: Grand Isle Tidal Datum**

| DESCRIPTION | NAVD88 (FT) |
|---|---|
| Highest Observed Water Level (08/29/2005) | 6.04 |
| Mean Higher High Water (MHHW) | 1.56 |
| Mean High Water (MHW) | 1.53 |
| Mean Sea Level (MSL) | 1.01 |
| Mean Tide Level (MTL) | 1.00 |
| Mean Low Water (MLW) | 0.48 |
| Mean Lower Low Water (MLLW) | 0.45 |
| North American Vertical Datum, 1988 (NAVD88) | 0.00 |
| Lowest Observed Water Level (2/3/1951) | -2.31 |

## 4.5 Storms

Table 4-6 presents hurricanes that impacted Scofield Island from 1985 to 2008. Storm selection was based primarily on landfall location, but also on wave height and water level elevations associated with the storm. Landfall locations were obtained from the NOAA Coastal Services Historical Hurricane storm track data (http://maps.csc.noaa.gov/hurricanes/).

**Table 4-6: Historical Hurricanes (1985-2008)**

| STORM NAME | YEAR* | MONTH* | DAY* | WIND SPEED* (KNOTS) | CATEGORY* |
|---|---|---|---|---|---|
| DANNY | 1985 | 8 | 15 | 80 | H1 |
| ELENA | 1985 | 9 | 2 | 100 | H3 |
| JUAN | 1985 | 10 | 29 | 70 | H1 |
| BONNIE | 1986 | 6 | 26 | 75 | H1 |
| ANDREW | 1992 | 8 | 26 | 120 | H4 |
| OPAL | 1995 | 10 | 4 | 110 | H3 |
| DANNY | 1997 | 7 | 18 | 65 | H1 |
| EARL | 1998 | 9 | 3 | 80 | H1 |
| GEORGES | 1998 | 9 | 28 | 90 | H2 |
| ISIDORE | 2002 | 9 | 26 | 55 | TS |
| LILI | 2002 | 10 | 3 | 80 | H1 |
| IVAN | 2004 | 9 | 16 | 105 | H3 |
| KATRINA | 2005 | 8 | 29 | 125 | H4 |
| RITA | 2005 | 9 | 24 | 100 | H3 |

| STORM NAME | YEAR* | MONTH* | DAY* | WIND SPEED* (KNOTS) | CATEGORY* |
|---|---|---|---|---|---|
| GUSTAV | 2008 | 9 | 1 | 95 | H2 |
| IKE | 2008 | 9 | 13 | 95 | H2 |

* at landfall

For the storm protection analysis (Section 6.1), the four most recent storms were considered. These included Hurricanes Katrina (2005), Rita (2005), Gustav (2008), and Ike (2008). Tracks of these storms are presented in Figure 4-5. Hurricane Katrina made landfall near Scofield Island as a Category 4 hurricane. According to the Grand Isle water level records, the highest observed water level in station's history occurred during Katrina when it was measured at approximately +6.0 feet NAVD88.

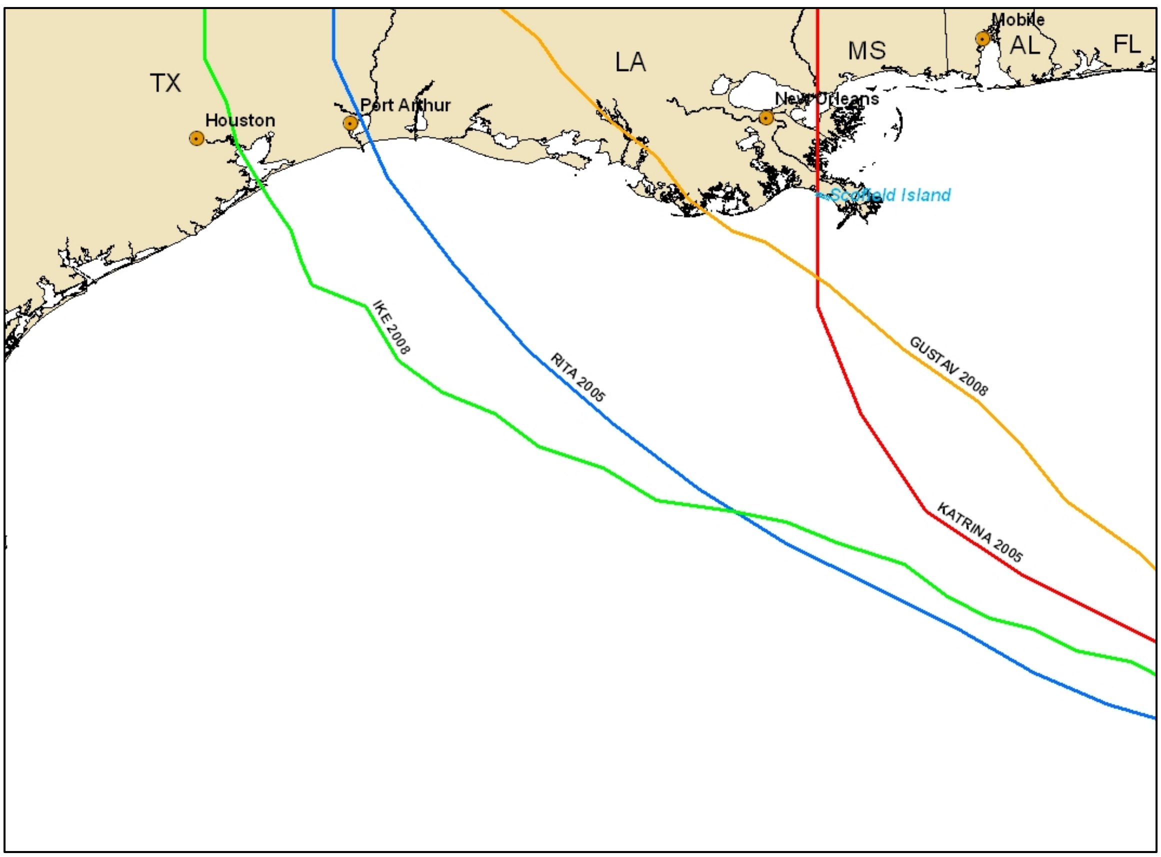


**Figure 4-5: Tracks of Recent Hurricanes**.

Water level, wave and wind data for the four hurricanes were assembled. Water level data were obtained from verified historical records at NOAA/NOS CO-OPS Station 8761724 located at the Coast Guard Station on Grand Isle. Wave and wind data were obtained from the NOAA/NWS/NCEP operational ocean wave predictions based on the output from the WAVEWATCH III model (http://polar.ncep.noaa.gov/waves/index2.shtml). The wave and wind data were obtained at a location (LAT=29.0N, LON=90.0W) 6.5 miles southwest of the WIS-

132 location. Figures 4-6 and 4-7 present the water level and wave data during Hurricanes Katrina and Rita, and Gustav and Ike, respectively.

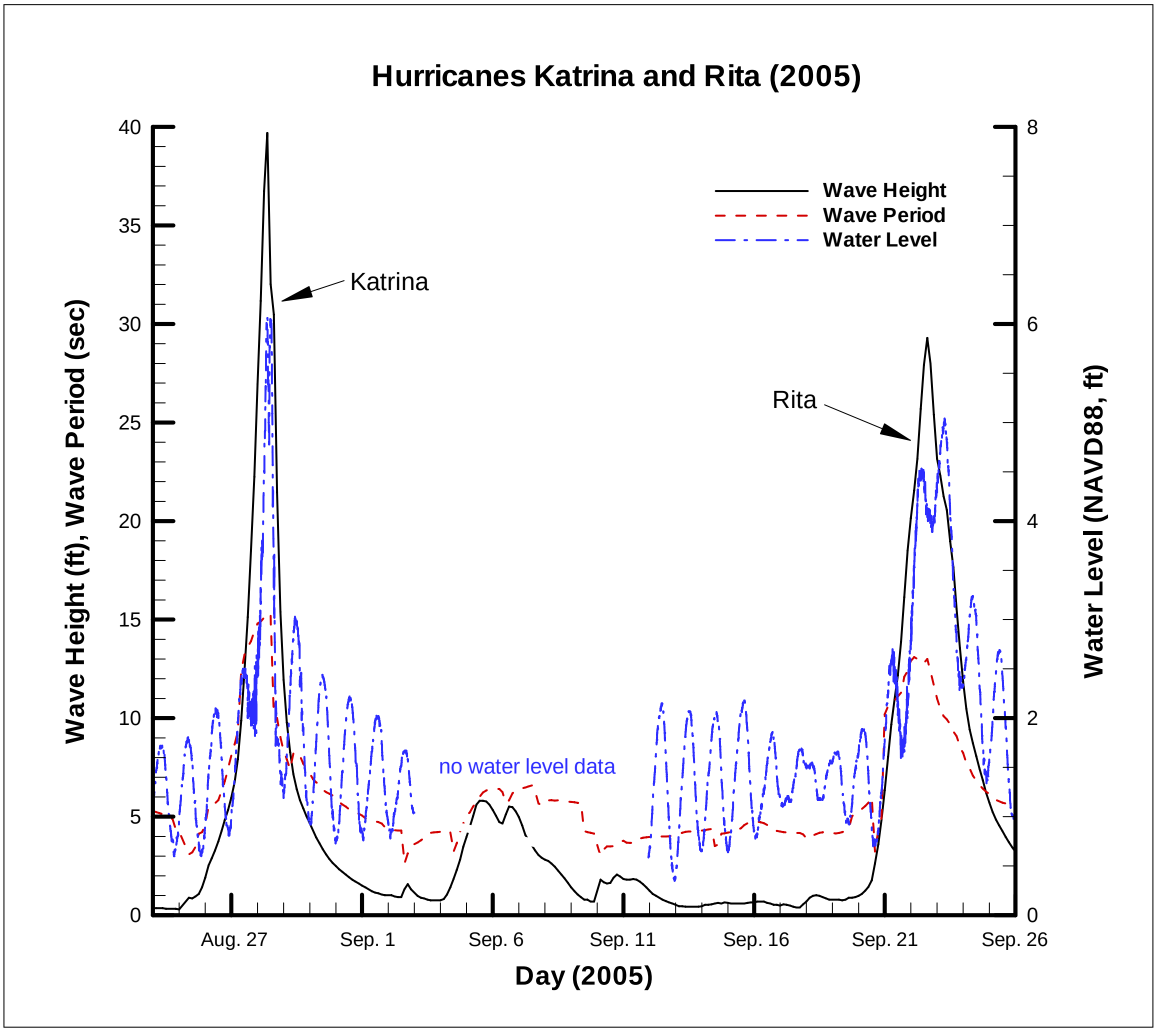


**Figure 4-6: Water Level and Wave Data During Katrina and Rita at Approximately WIS-132.**

The largest wave heights during Katrina and Rita at WIS-132 were approximately 39.4 feet and 29.3 feet, respectively. The maximum water levels that occurred at the Grand Isle Station were +6.0 feet NAVD88 and +5.0 feet NAVD88, respectively.

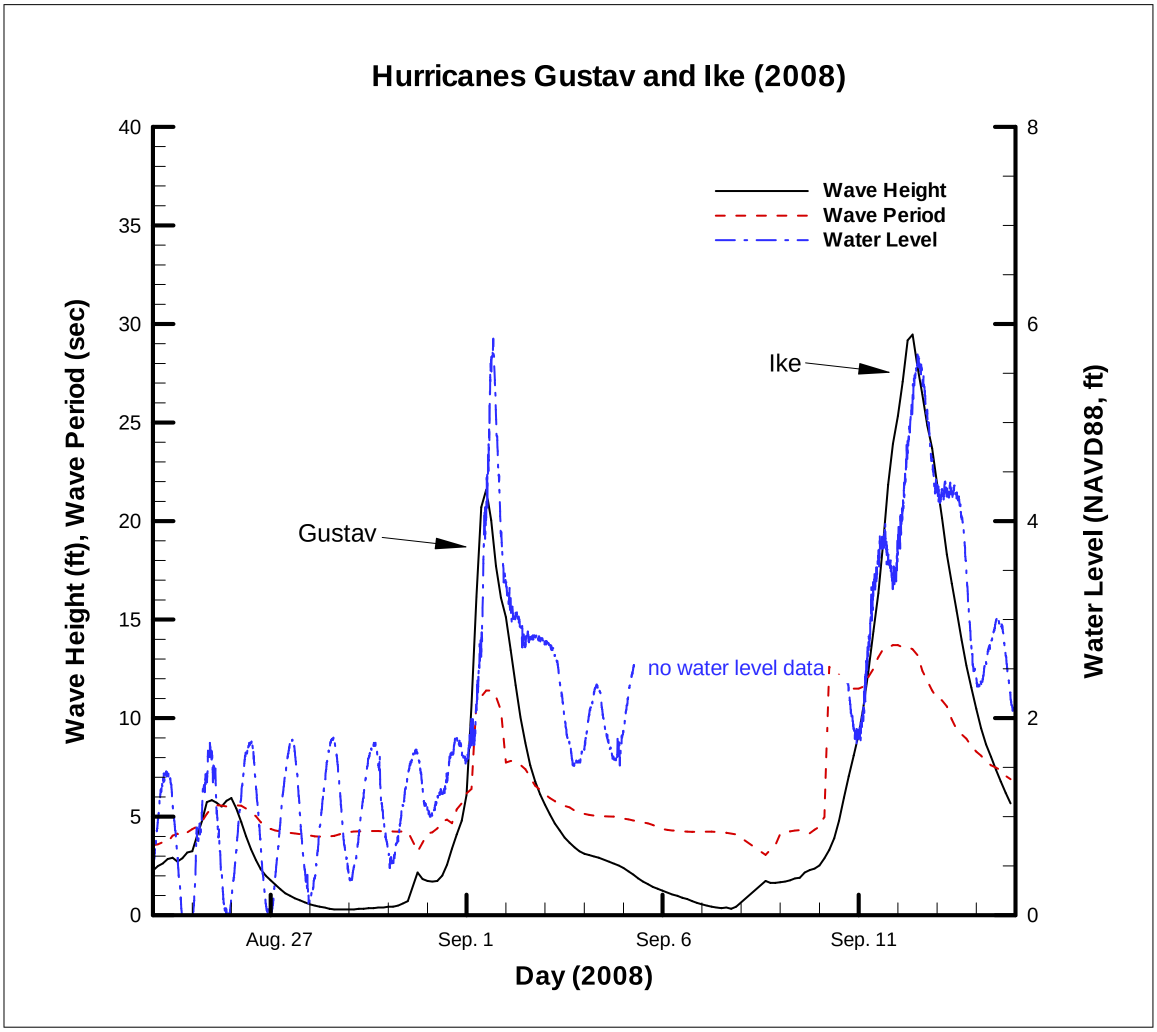


**Figure 4-7: Water Level and Wave Data During Gustav and Ike at Approximately WIS-132.**

The largest wave heights during Gustav and Ike at WIS-132 were approximately 21.3 feet and 29.4 feet, respectively. The maximum water levels that occurred at the Grand Isle Station were +5.8 feet NAVD88 and +5.7 feet NAVD88, respectively.

Figures 4-8 and 4-9 present the wind data during Katrina and Rita, and Gustav and Ike, respectively. The maximum wind speeds during Katrina, Rita, Gustav, and Ike were approximately 78 mph, 56 mph, 45 mph, and 49 mph, respectively.

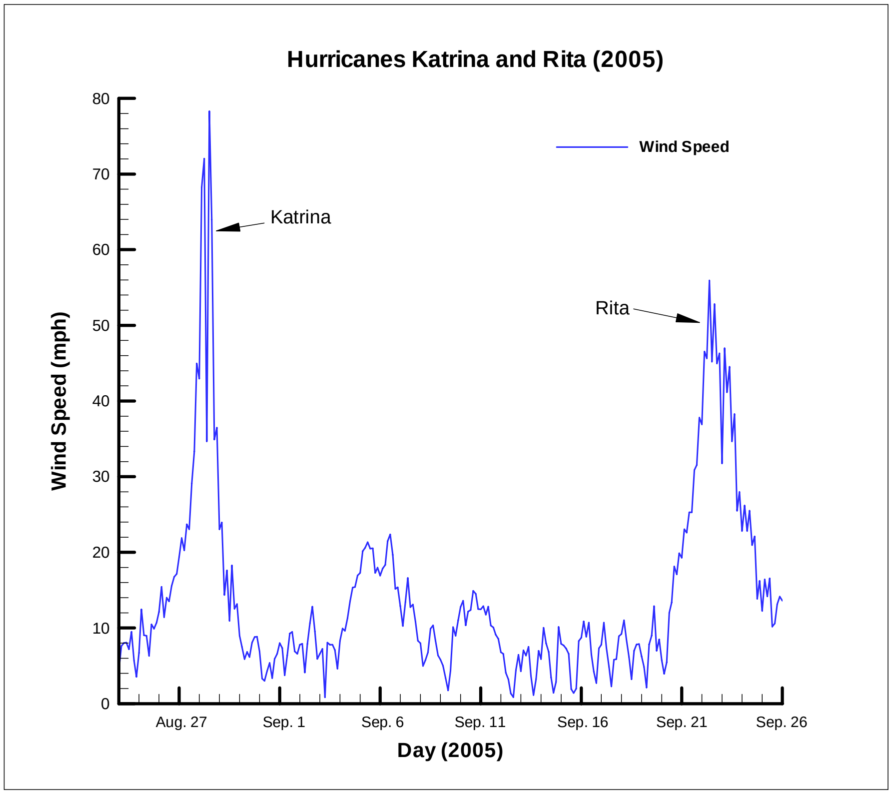


**Figure 4-8: Wind Speed During Katrina and Rita at Approximately WIS-132.**

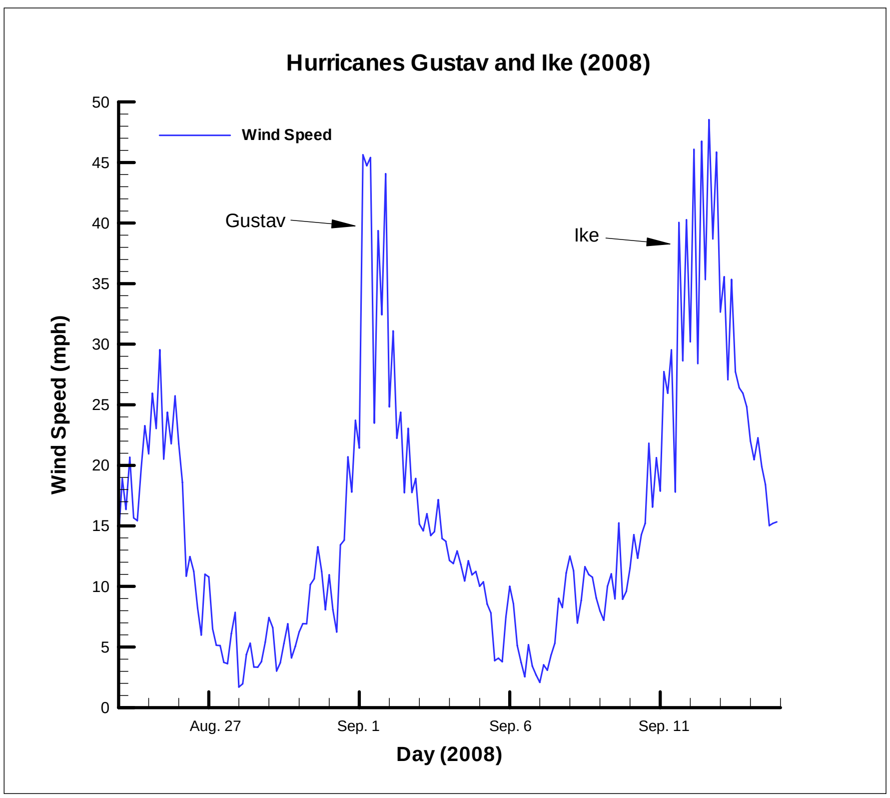


**Figure 4-9: Wind Speed During Gustav and Ike at Approximately WIS-132.**

### 4.6 Sea Level Rise and Subsidence

According to NOAA (http://tidesandcurrents.noaa.gov), the mean sea level trend at Grand Isle, LA is 9.24 millimeters/year with a 95% confidence interval of +/- 0.59 millimeters/year which is equivalent to a change of 3.0 feet in 100 years. Figure 4-10 presents the trend based on monthly mean sea level data from 1947 to 2006.

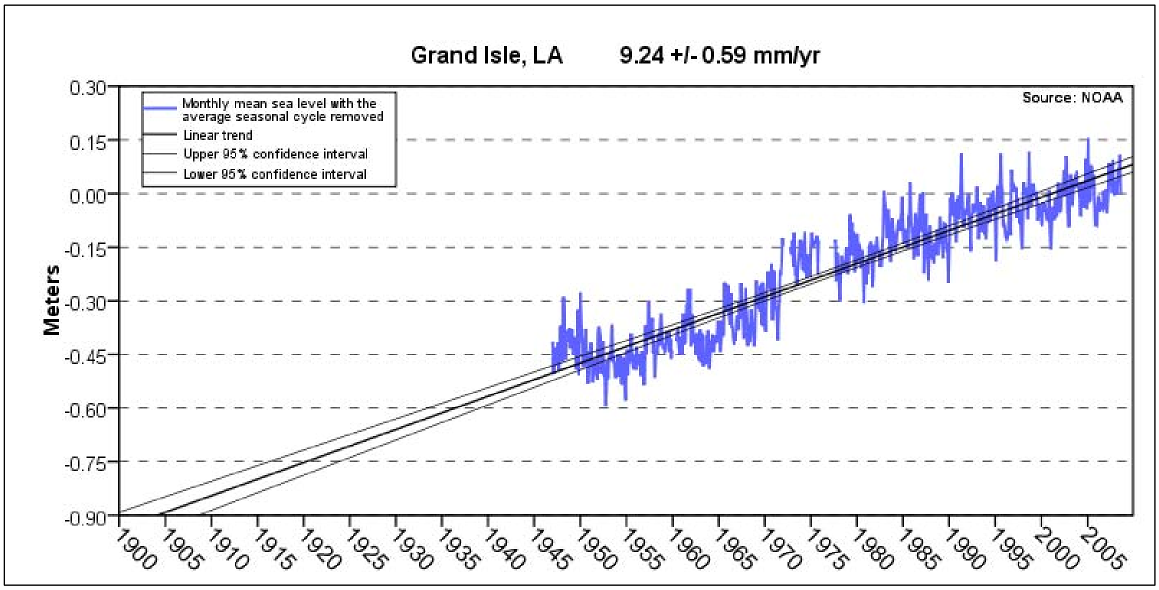


**Figure 4-10: Sea Level Rise at Grand Isle.**

Estimates of geologic subsidence vary from 2.5 feet per century to 2.9 feet per century within the Coastal Wetland Planning, Protection and Restoration Act geotechnical reports including Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration (BA-35) (STE, 2004), Chaland Headland Restoration (BA-38) (STE, 2003), and East and West Grand Terre Island Restoration (BA-30) (MPH and Eustis, 2004). Based on estimates used for past barrier island projects, e.g. BA-30 and BA-35, a rate of 2.5 feet per century is used for this analysis.

Based on the sea level rise and geologic subsidence rates presented above, the relative sea level rise rate which combines the two is estimated to be approximately 5.5 feet in 100 years or 0.055 feet per year.

### 4.7 Depth of Closure

The depth of closure is defined as the seaward limit of active sand transport. It is determined by one of two methods, either empirically or using historic profile comparisons. Both methods were employed herein and the depth of closure defined accordingly.

### 4.7.1 Empirical Computations

WIS-132 data were utilized to compute the “effective” wave height, $H_e$, which is the significant wave height that is exceeded during only 12 hours per year. The effective wave height at WIS-132 was equal to 11.1 feet and the associated period, $T_e$, was equal to 8.0 seconds. The STWAVE model was used to propagate the WIS-132 effective wave closer to the shore. The calculated nearshore effective wave height and period were 7.6 feet and 7.7 seconds, respectively. These data were used to calculate the depth of closure, $h_c$, by applying the empirical method developed by Hallermeier (1981):

$$h_c = 2.28H_c - 68.5\left(\frac{H_e^2}{gT_e^2}\right)$$

The calculated depth of closure was equal to approximately 11.6 feet referenced to Mean Sea Level (MSL) or approximately -10.6 feet NAVD88.

### 4.7.2 Comparisons with the Literature

A review of recent Louisiana projects was conducted to identify the published depth of closure values in similar geologic settings experiencing similar coastal processes. USACE (July 2004) computed the depth of closure equal to -12 feet NAVD88 on Grand Isle. SJB and CEC (2005) computed the depth of closure equal to -11 feet NAVD88 for CWPPRA Project BA-35, Pass Chaland to Grand Bayou Barrier Restoration Project.

### 4.7.3 Profile Comparisons

Empirical methods should be considered in conjunction with other pertinent information and analyses when determining the seaward depth of closure (Birkemeier, 1985 and Hallermeier, 1981), defined as the seawardmost point at a consistent elevation along the shoreline at which profile differential elevation changes end, that is, are on the order of a few tenths of a foot and within the accuracy of the surveys. Although historic profile comparisons are limited, an analysis of the 2004 and 2008 surveyed profiles was performed. Figures 3-7 and 3-8, which are presented in Chapter 3 – Surveying and Mapping, depict two beach profiles and evidence of profile correlation is observed in the nearshore zone between -10 and -12 feet NAVD88, relating well to the published depth of closure values for recent Louisiana projects described above and to the empirical calculation. Therefore, the depth of closure value of -10.6 feet NAVD88 is recommended for use in the Project design.

## 4.8 Sediment Budget

### 4.8.1 1998-2002 and 2000-2002 Pelican Island Sediment Budgets by CPE

CPE developed short-term, 2000 to 2002, and long-term, 1988 to 2002, sediment budgets for Pelican Island, located west of Scofield Island across Scofield Bayou (CPE, 2003). The two sediment budgets are presented in Figures 4-11 and 4-12. According to these budgets, easterly short-term and long-term transport volumes across Scofield Bayou were 45,500 cubic yards/year and 10,000 cubic yards/year, respectively.

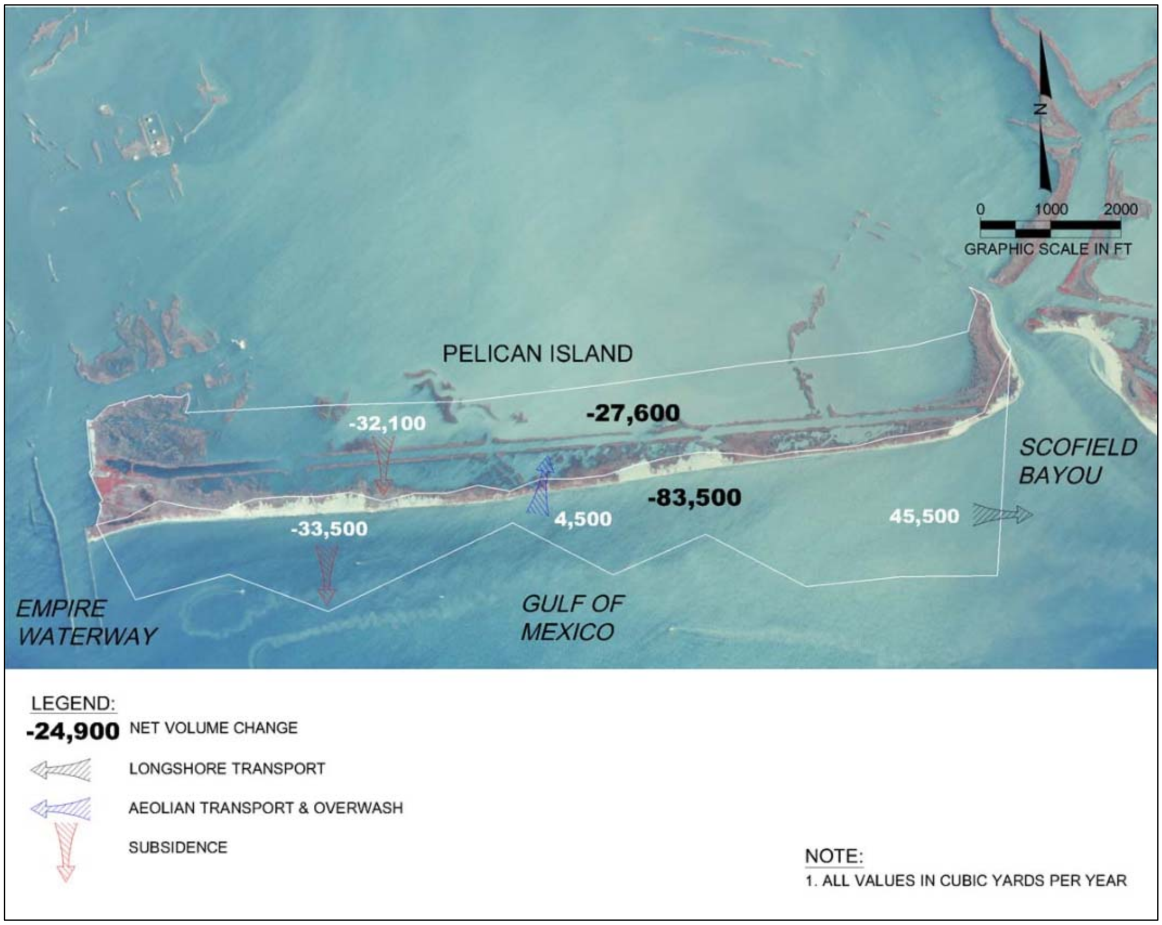


**Figure 4-11: 2000-2002 CPE Sediment Budget (from CPE (2003)).**

The net gulf-side cell erosion losses were 83,500 cubic yards per year and 50,700 cubic yards per year for the short-term and long-term budgets, respectively. The net marsh-side cell erosion losses were 27,600 cubic yards per year and 24,900 cubic yards per year for the short-term and long-term budgets, respectively.

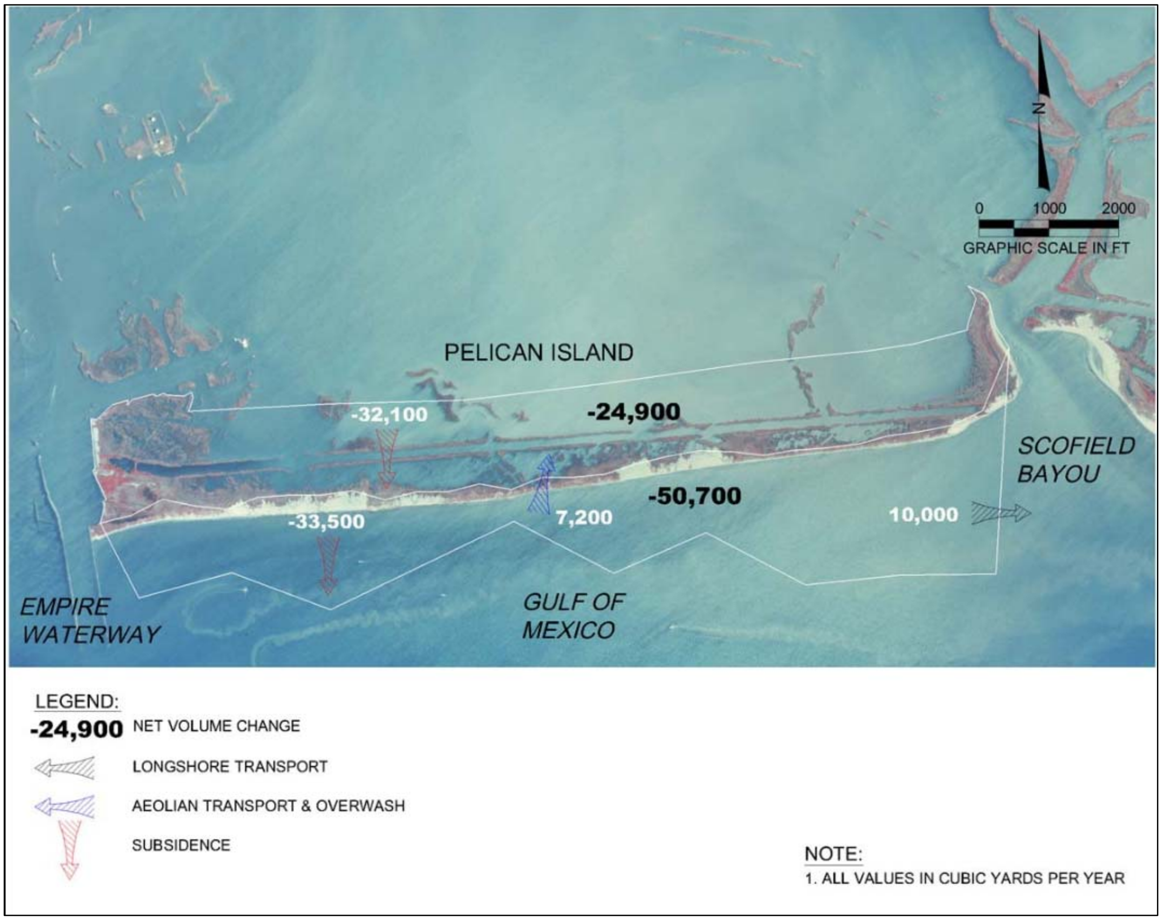


**Figure 4-12: 1988-2002 CPE Sediment Budget (from CPE (2003)).**

### 4.8.2 2000-2004 Scofield Island Sediment Budget by ATM

ATM (2004) developed a sediment budget for Scofield Island based on the observed shoreline changes between 2000 and 2004. Two cells were defined, marsh platform and dune/beach face. The volumetric change in the marsh platform was calculated using the estimated subsidence rate and the plan view area of the marsh area bounded by the dunes and the location of the primary construction dike. The volumetric change for the dune/beach face cell was estimated based on the observed shoreline changes from 2000 to 2004 and a depth of closure of -7 feet NAVD88. The marsh platform and dune/beach face cells were linked by the predicted annualized overwash due to storm events. The dune/beach face cell also accounted for the relative sea level rise and resulting shoreline retreat, which was a component of the observed shoreline changes. The ATM sediment budget is presented in Figure 4-13. According to the budget, Scofield Island was predicted to lose an average of 37,200 cubic yards/year due to relative sea level rise. Approximately 1,200 cubic yards/year of material would be overwashed from the dune/beach face into the marsh platform due to predicted storm impacts. Based on the 2000 to 2004 shoreline losses, an average net volume change of approximately -40,500 cubic yards per year was predicted for the gulf-side cell. It was estimated that an average of 15,000 cubic yards/year of material would be deposited to the ebb shoal of Scofield Bayou, and approximately 9,600 cubic yards per year would be lost offshore from the east end of Scofield Island.

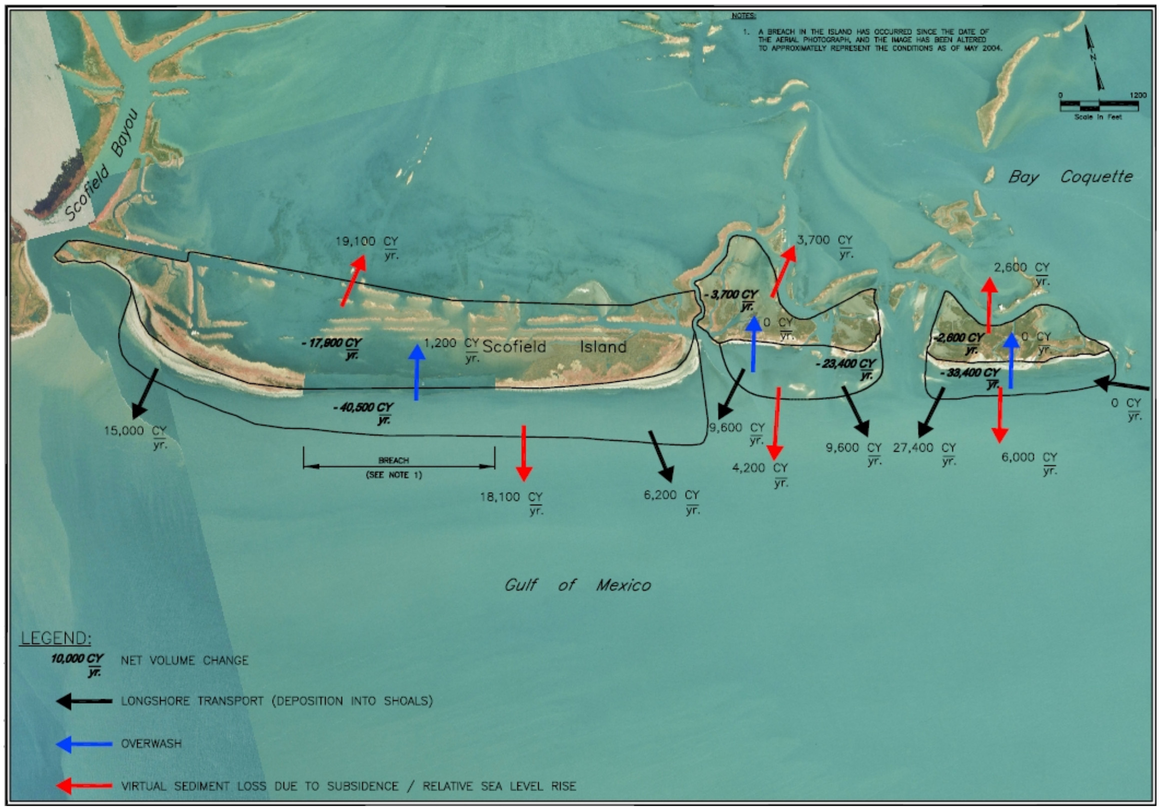


**Figure 4-13: 2000-2004 ATM Sediment Budget (from ATM (2004)).**

### 4.8.3 Scofield Island Design Sediment Budget

Figure 4-14 presents a Scofield Island design sediment budget developed by CEC based on volumetric changes that occurred between 2000 and 2004 before the major breach occurred in the middle of the island in 2005, caused by Hurricane Katrina. The budget consists of two cells, gulf-side and marsh-side. The gulf-side cell extends from the depth of closure to the approximate seaward limits of the existing marsh areas. The marsh-side cell encompasses the existing marsh areas and the projected back-barrier marsh creation area including the affects of overwash during the 20-year Project life.

The total net gulf-side cell erosion loss between 2000 and 2004, calculated in Section 3.3.2, Volume Changes, was equal to 133,500 cubic yards per year. To balance the sediment budget, the ATM (2004) longshore transport rates developed for the same period of time were utilized, the westerly longshore transport rate of 15,000 cubic yards per year and the easterly longshore transport rate of 9,600 cubic yards per year. Using the 0.025 feet per year geologic subsidence rate (Section 4.6) and the gulf-side cell and marsh-side cell acreages yields approximately 39,400 cubic yards per year and 34,400 cubic yards per year of erosion loss due to subsidence for the gulf-side and marsh-side cells, respectively.

The total overwash rate transported from the gulf-side cell to the marsh-side cell is then computed by subtracting the gulf-side cell geologic subsidence rate and longshore transport rates from the net gulf-side erosion loss, yielding approximately 69,500 cubic yards per year of overwash.

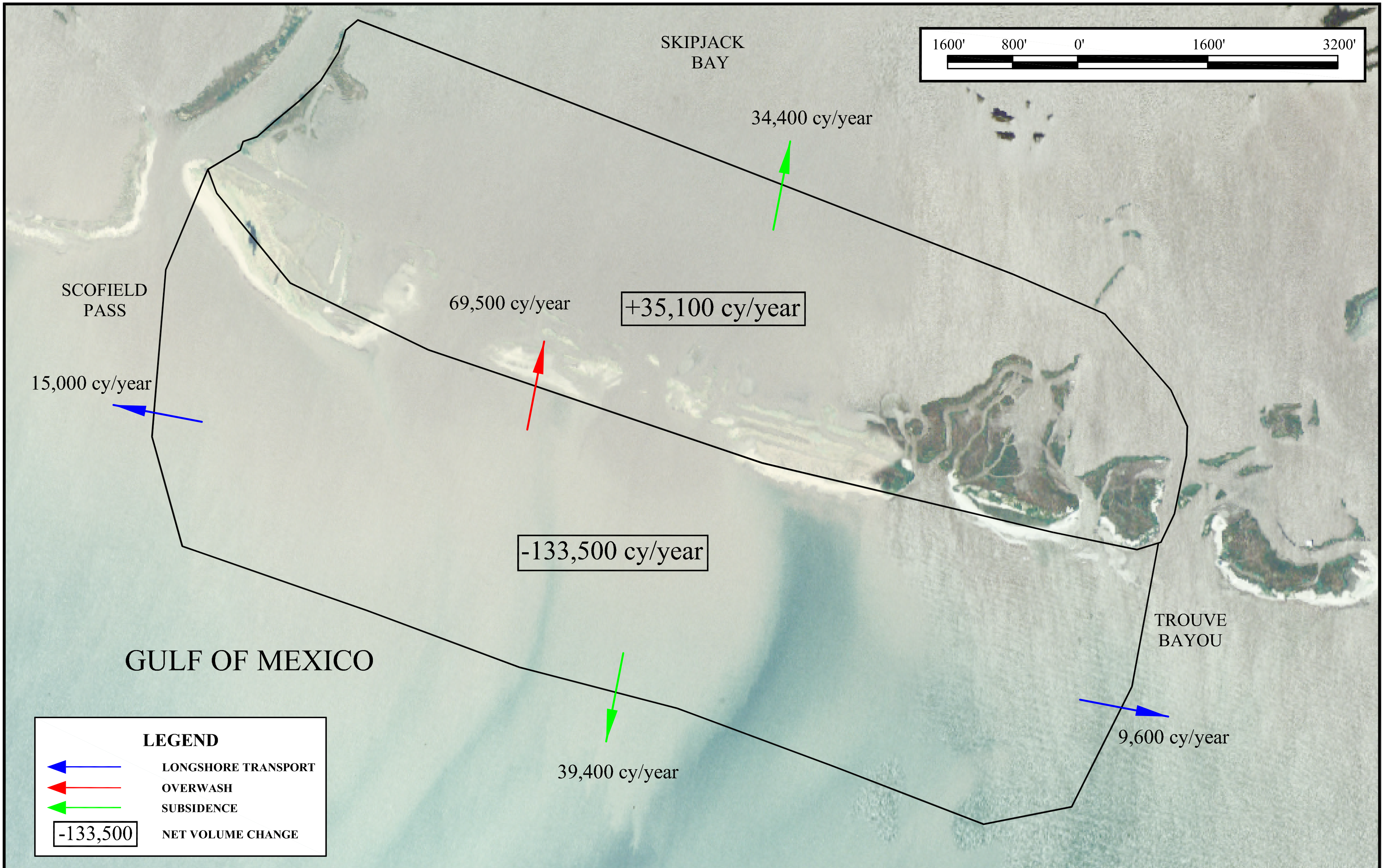


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FIGURE 4-14: SCOFIELD ISLAND SEDIMENT BUDGET

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## 5.0 DESCRIPTION OF ALTERNATIVES

### 5.1 Design Objectives

Four (4) alternatives were developed, including a "no action" alternative and three (3) beach/dune/marsh fill alternatives, to achieve the CWPPRA goals for island restoration that include:

- Create beach, dune, and back-barrier marsh to protect and preserve the structural integrity of the barrier shoreline for a Project life of 20 years;
- Achieve a marsh platform elevation such that by Year 3 the marsh elevation is within the tidal zone, defined from MHW to MLW, and remains within this zone through Year 20;
- Yield approximately 278 acres of back-barrier island habitat at Year 20.

#### 5.1.1 Marsh Fill

The Project includes design of a marsh platform contiguous with the northern side of the gulf-front shoreline along Scofield Island to restore and maintain the barrier shoreline. To achieve the tidal zone design objective, the target elevation of the marsh platform is +3.0 feet NAVD88. The marsh platform shall be planted with appropriate vegetation.

#### 5.1.2 Beach and Dune Fill

The Project includes design of a beach and dune fill to address gulf-front erosion and close the breaches. Various fill templates were evaluated during the modeling tasks to balance technical, fiscal, and environmental factors that best optimized Project performance. The dune width and slope were designed to match existing healthy dunes in the Project area. Sand fencing shall be installed along the dune platform following construction. The fencing shall be 4 feet high with 50% porosity (*i.e.*, ratio of area of open space to total fence area) placed shore-parallel along the entire length of the dune to capture wind-blown sand and to help build and stabilize mounds. The dune platform shall be planted with appropriate vegetation.

### 5.2 Alternative 1

This alternative is to allow for conditions to remain in their present state and no construction is included in this alternative. The Project area is experiencing a loss rate of over 3.7 acres per year since 2000 (Section 6.3). By applying this loss rate, the short–term year of disappearance was predicted to be 2044. This alternative does not achieve any of the design objectives, thus it was not considered to be a practical alternative.

### 5.3 Alternative 2

This alternative is designed to provide an approximate 11,400 foot long beach and dune fill with approximately 2,100 foot and 1,800 foot tapers on west and east end, respectively, to close the breach areas and restore and protect the erosive beach. The tapers are provided to blend the sediments into the existing grades and maintain a buffer from the inlets on both ends of Scofield Island. The dune component includes a 50 foot wide crest width at +6 feet NAVD88 with 1:45 side slopes. The beach fill template includes a 100 foot wide construction berm at +4 feet NAVD88 with 1:45 side slopes. The elevations were chosen to correspond to storm surge levels between the 5- and 10-year storm events to minimize overtopping into the marsh. The average beach fill width measured at MHW is approximately 640 feet, excluding the tapers. The surface area of the proposed beach platform is approximately 223 acres measured at +4 feet NAVD88. The required fill volume is approximately 2.03 million cubic yards including the preliminary design criteria for the overfill ratio and two years of background gulf-side erosion. The required excavation volume including the preliminary design criteria for the cut to fill ratio is approximately 2.64 million cubic yards. The average beach and dune fill density for Alternative 2 is 176.8 cubic yards per linear foot along the island.

This alternative is also designed to provide an approximately 11,800 foot long marsh platform on the bay side of Scofield Island. The marsh platform's width varies, ranging from approximately 1,000 feet on the west end of the island to approximately 2,100 feet near the east end of the island, to conform to the existing marsh geometry. The surface area of the proposed marsh platform is approximately 375 acres. The target marsh platform elevation is +3.0 feet NAVD88 accounting for the preliminary design criteria on average existing marsh elevation, sea level rise, subsidence and consolidation. The required fill volume is approximately 1.74 million cubic yards accounting for two years of background overwash into the marsh cell. The required excavation volume including the preliminary design criteria for the cut to fill ratio is approximately 2.79 million cubic yards. The average marsh fill density for Alternative 2 is 150.3 cubic yards per linear foot along the marsh platform.

A plan view for Alternative 2 is presented in Figure 5-1. The Alternative 2 cross-sections are presented in Figures 5-2 through 5-6.

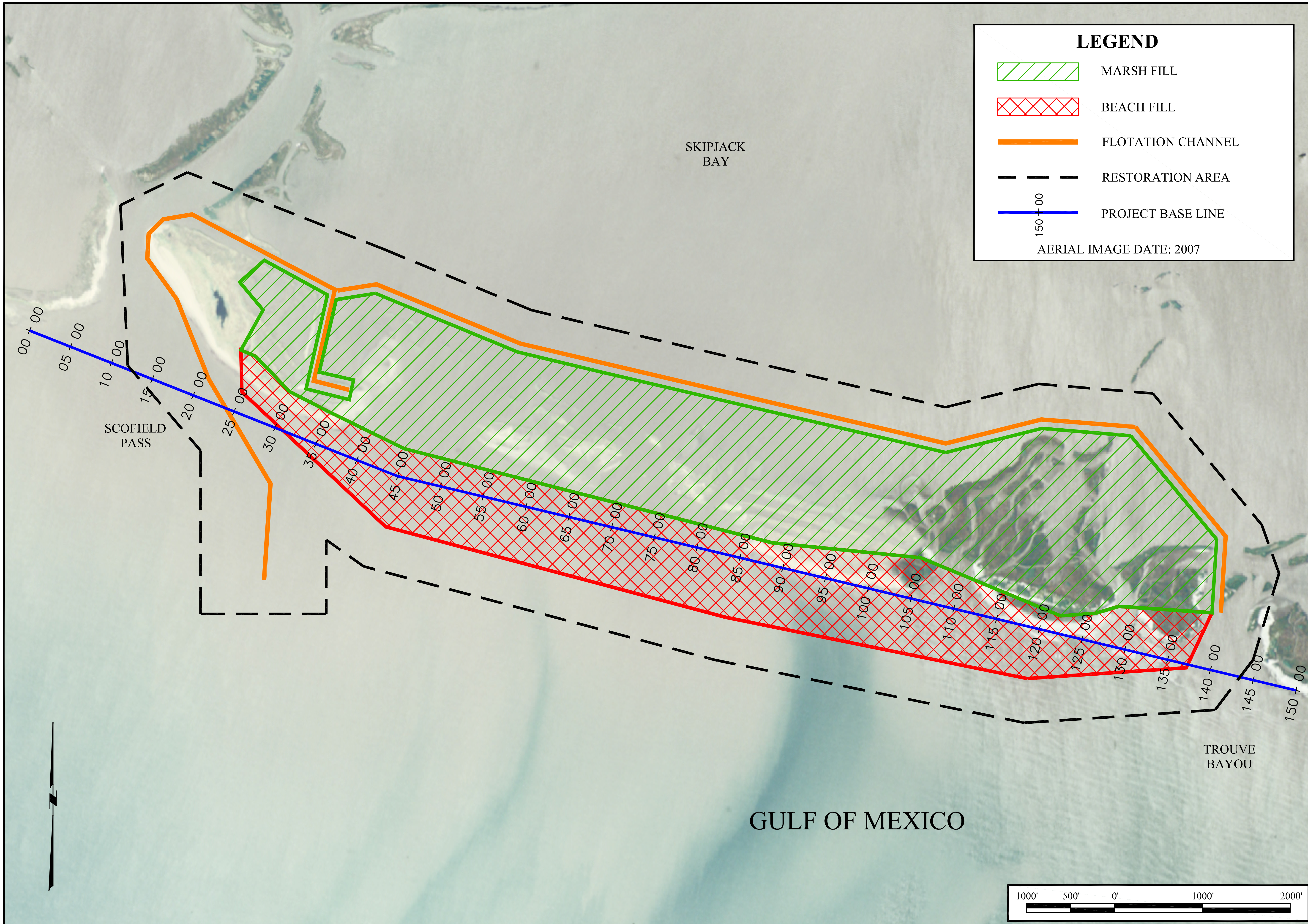


FIGURE 5-1: SCOFIELD ISLAND ALTERNATIVE 2
PLAN VIEW

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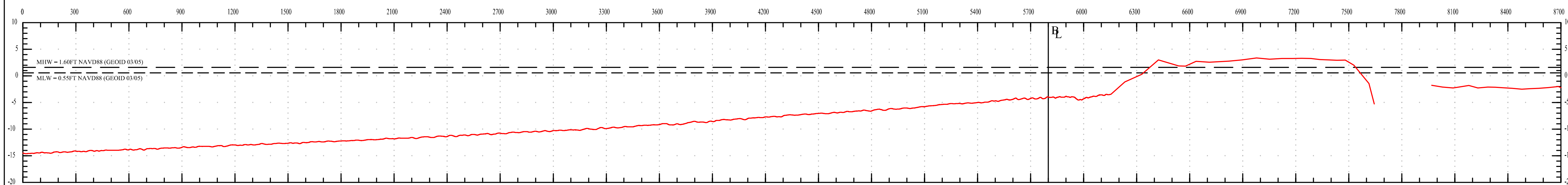
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

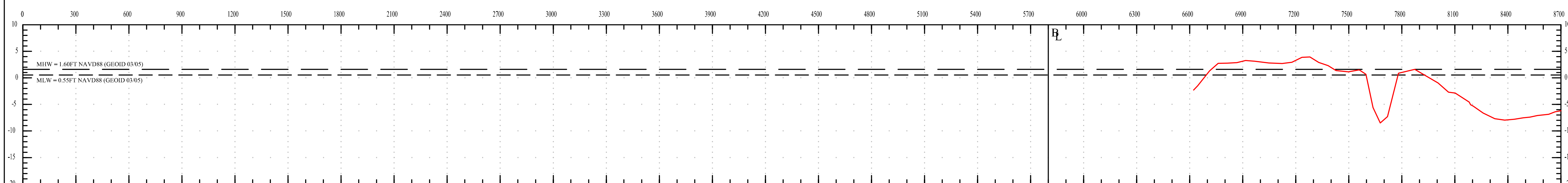
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

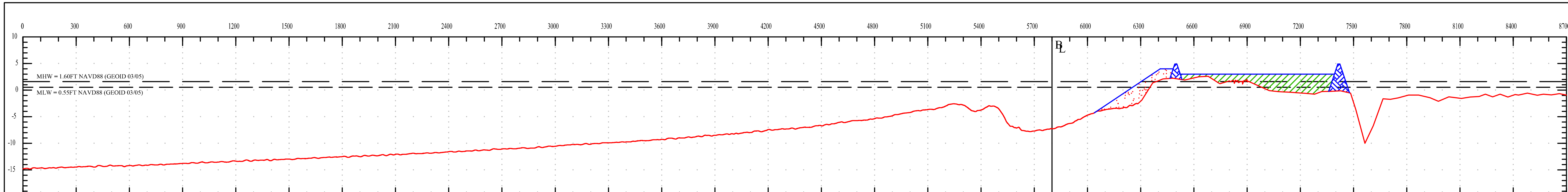
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 2 - STATION 05+00
DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 2 - STATION 15+00
DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 2 - STATION 25+00
DISTANCE ALONG BASELINE (FT)

BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY

# FIGURE 5-2: SCOFIELD ISLAND ALTERNATIVE 2 CROSS SECTIONS

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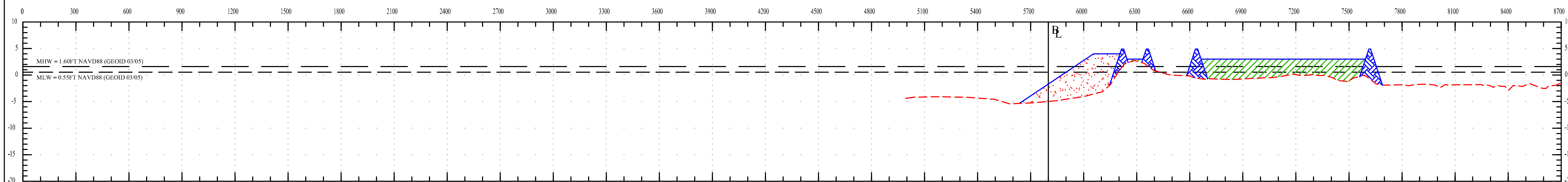
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

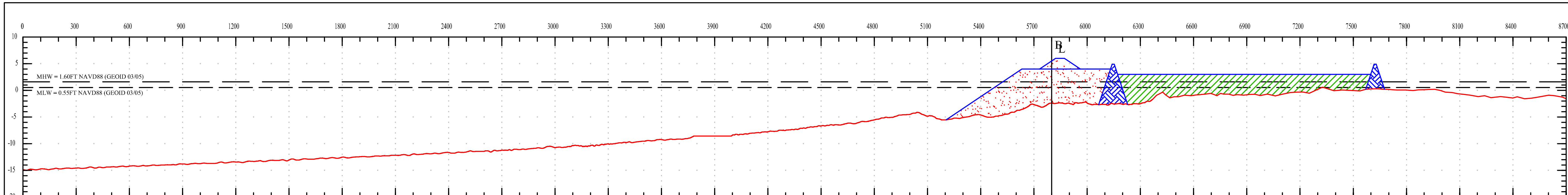
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

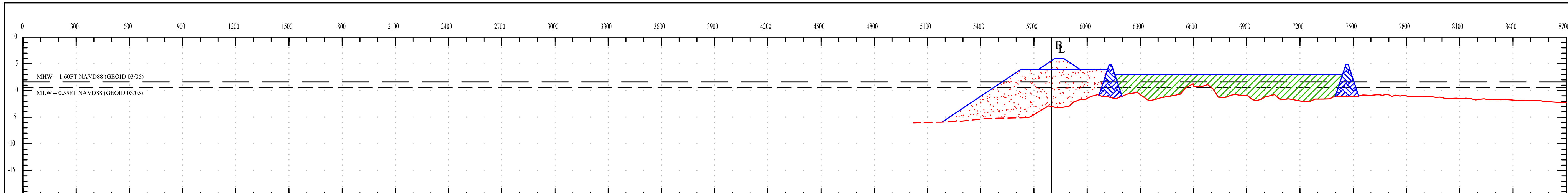
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 2 - STATION 35+00 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 2 - STATION 45+00 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 2 - STATION 55+00 DISTANCE ALONG BASELINE (FT)

BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY


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FIGURE 5-3: SCOFIELD ISLAND ALTERNATIVE 2
CROSS SECTIONS


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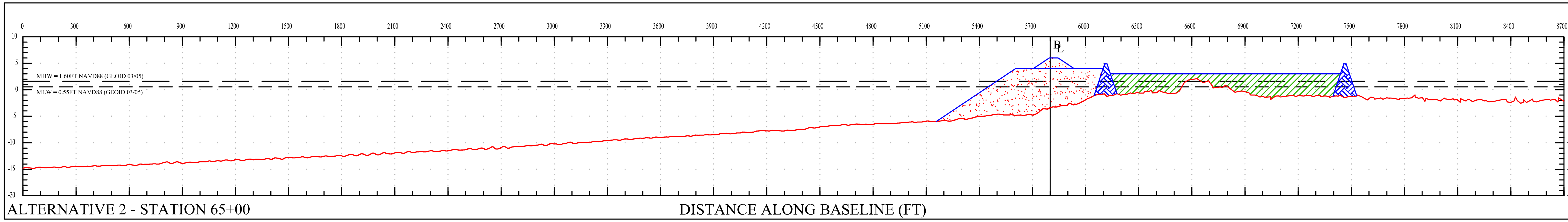
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

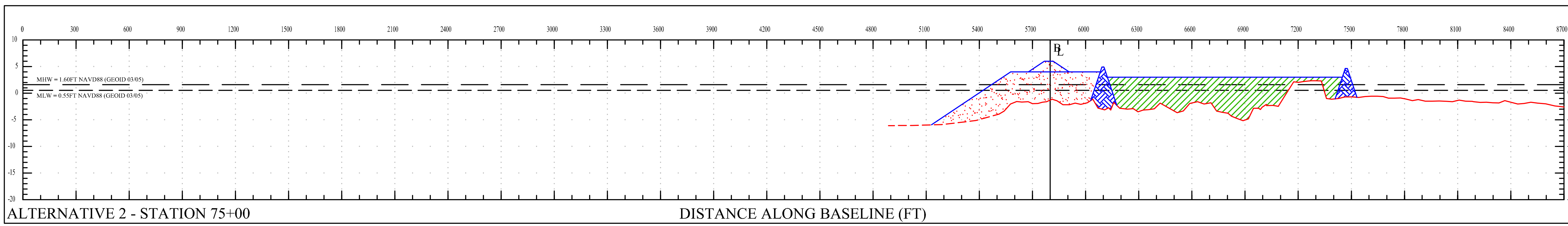
# PRELIMINARY DESIGN PARAMETERS

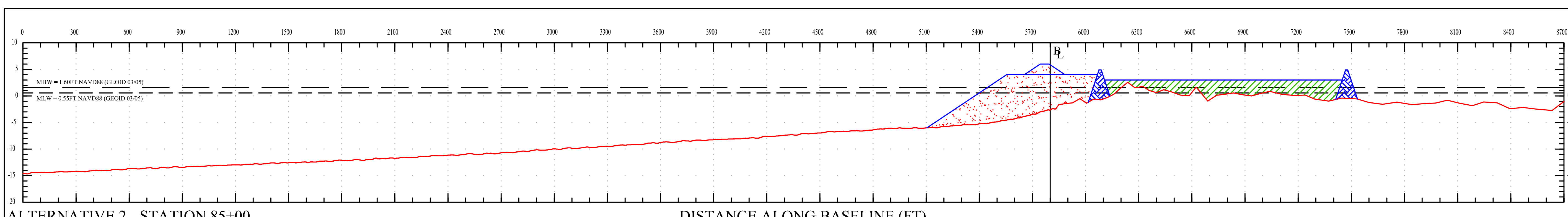
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY

FIGURE 5-4: SCOFIELD ISLAND ALTERNATIVE 2
CROSS SECTIONS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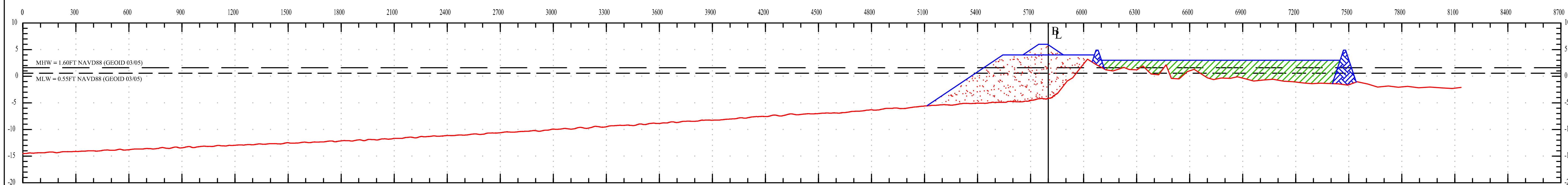
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

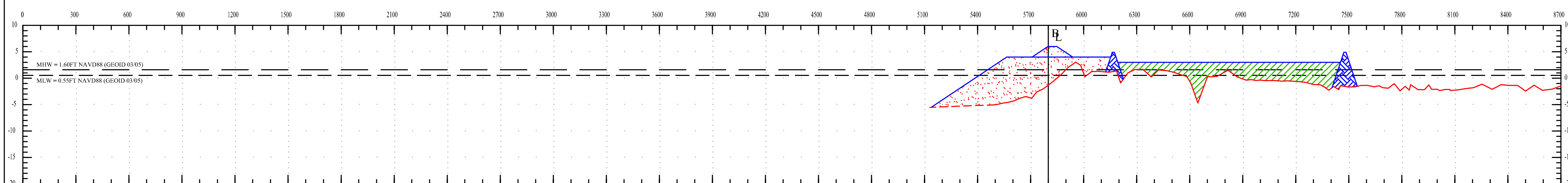
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

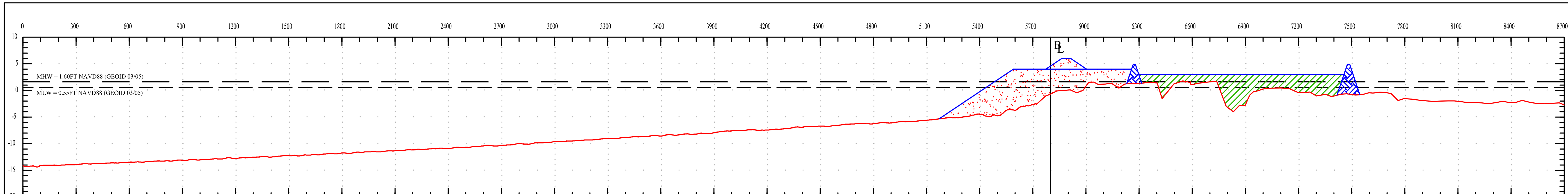
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 2 - STATION 88+15 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 2 - STATION 95+00 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 2 - STATION 105+00 DISTANCE ALONG BASELINE (FT)

BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY

# FIGURE 5-5: SCOFIELD ISLAND ALTERNATIVE 2 CROSS SECTIONS

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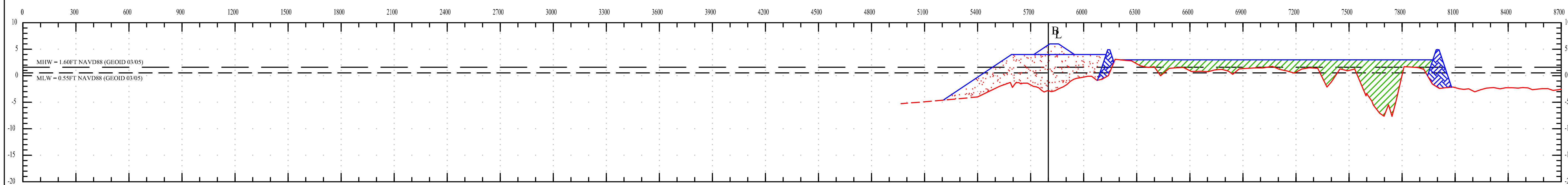
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

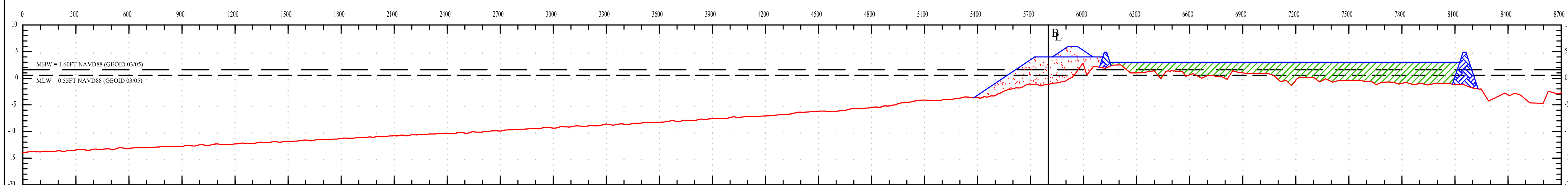
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

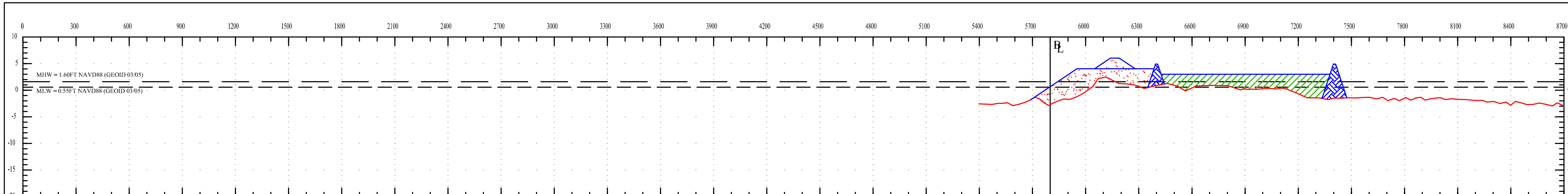
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 2 - STATION 115+00 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 2 - STATION 125+00 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 2 - STATION 135+00 DISTANCE ALONG BASELINE (FT)

BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY

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FIGURE 5-6: SCOFIELD ISLAND ALTERNATIVE 2 CROSS SECTIONS

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## 5.4 Alternative 3

This alternative is designed to provide an approximate 11,400 foot long beach and dune fill with approximately 2,100 foot and 1,800 foot tapers on west and east end, respectively, to close the breach areas and restore and protect the eroding beach. The tapers are provided to blend the sediments into the existing grades and maintain a buffer from the inlets on both ends of Scofield Island. Compared to Alternative 2, the beach and dune fill was translated northward and it covers more of the existing island framework. The dune component includes a 50 foot wide crest width at +6 feet NAVD88 with 1:45 side slopes. The beach fill template includes a 100 foot wide construction berm at +4 feet NAVD88 with 1:45 side slopes. The elevations were chosen to correspond to storm surge levels between the 5- and 10-year storm events to minimize overtopping into the marsh. The average beach fill width measured at MHW is approximately 690 feet excluding the tapers. The surface area of the proposed beach platform is approximately 221 acres measured at +4 feet NAVD88. The required fill volume is approximately 1.72 million cubic yards including the preliminary design criteria for the overfill ratio and two years of background gulf-side erosion. The required excavation volume including the preliminary design criteria for the cut to fill ratio is approximately 2.24 million cubic yards. The average beach and dune fill density for Alternative 3 is 150.0 cubic yards per linear foot along the island.

This alternative is also designed to provide an approximately 10,600 foot long marsh platform on the bay side of Scofield Island. The marsh platform’s width varies ranging from approximately 1,400 feet on the west end of the island to approximately 2,400 feet near the east end of the island to preserve an approximate 40 acre area of the existing healthy marsh. The area of the proposed marsh platform is approximately 319 acres. The target marsh platform elevation is +3.0 feet NAVD88 accounting for the preliminary design criteria on average existing marsh elevation, sea level rise, subsidence and consolidation. The required fill volume is approximately 1.76 million cubic yards accounting for two years of background overwash into the marsh cell. The required excavation volume including the preliminary design criteria for the cut to fill ratio is approximately 2.82 million cubic yards. The average marsh fill density for Alternative 3 is 151.9 cubic yards per linear foot along the marsh platform.

A plan view for Alternative 3 is presented in Figure 5-7. The Alternative 3 cross-sections are presented in Figures 5-8 through 5-12.

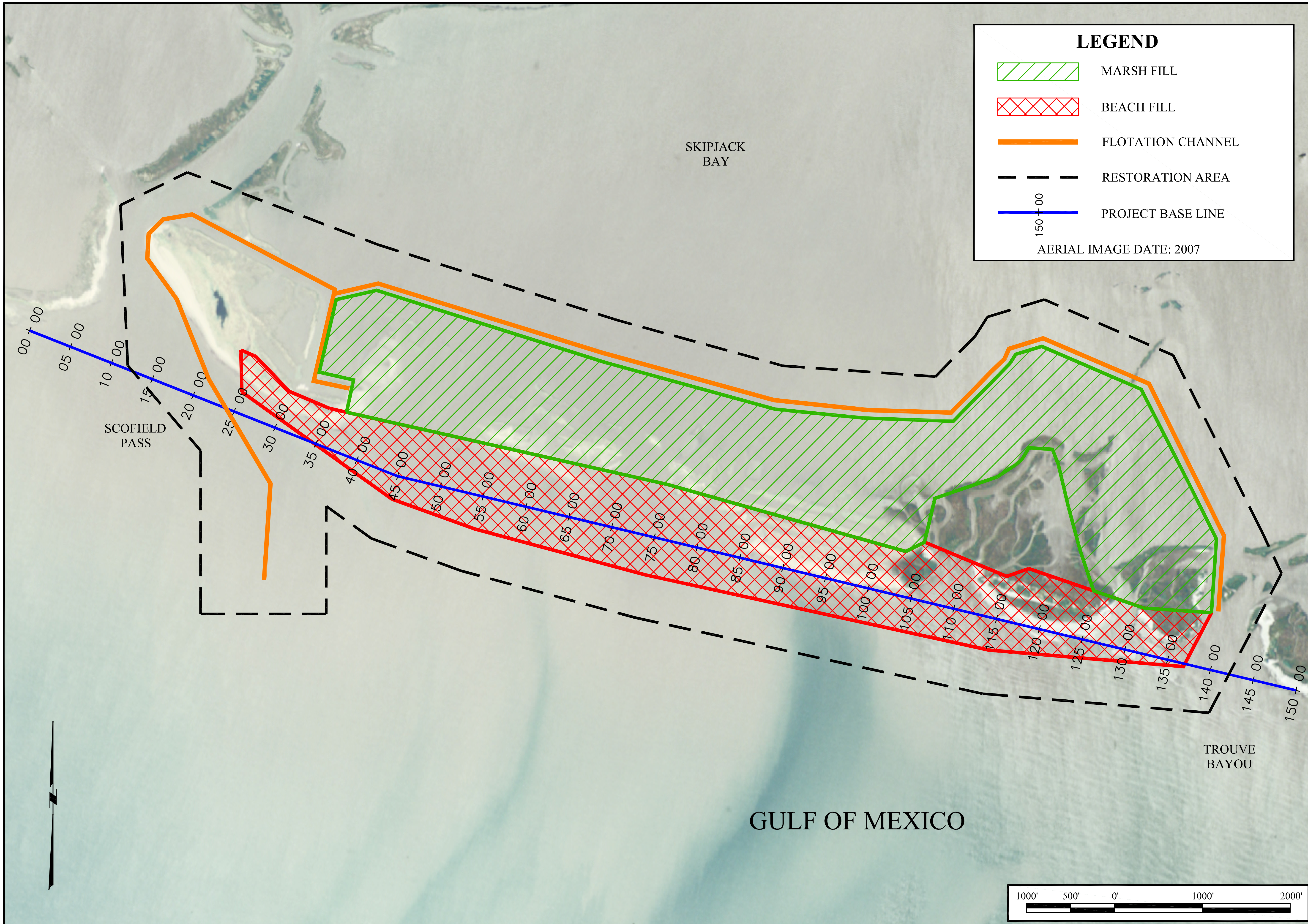


FIGURE 5-7: SCOFIELD ISLAND ALTERNATIVE 3
PLAN VIEW

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SJB GROUP, LLC
QUALITY BY DESIGN
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BATON ROUGE, LA. 70821
PHONE (225) 769-3400
FAX (225) 769-3596

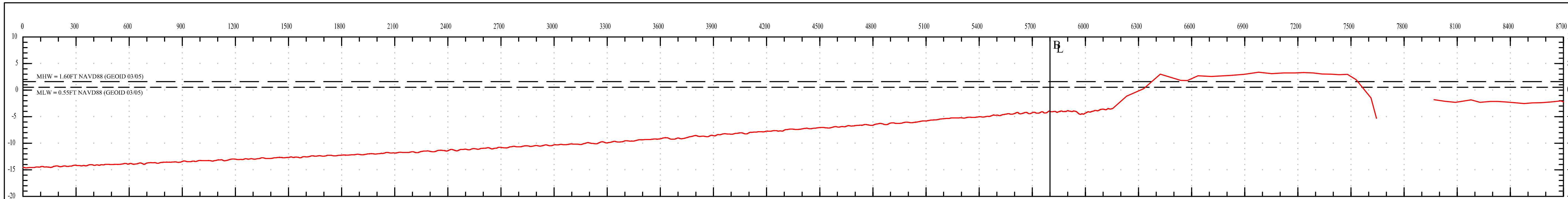
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

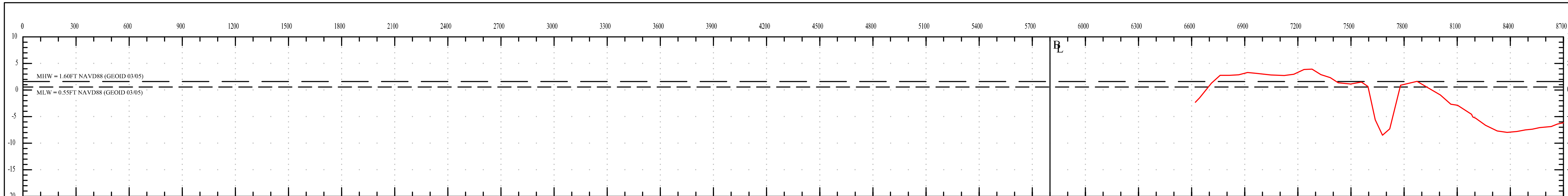
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

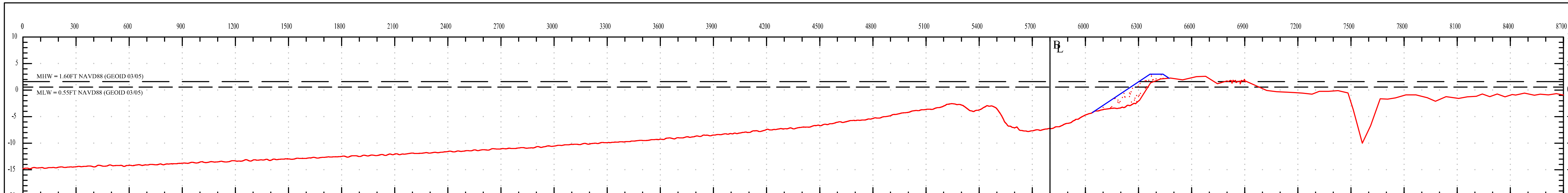
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 3 - STATION 05+00 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 3 - STATION 15+00 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 3 - STATION 25+00 DISTANCE ALONG BASELINE (FT)

BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY

# FIGURE 5-8: SCOFIELD ISLAND ALTERNATIVE 3 CROSS SECTIONS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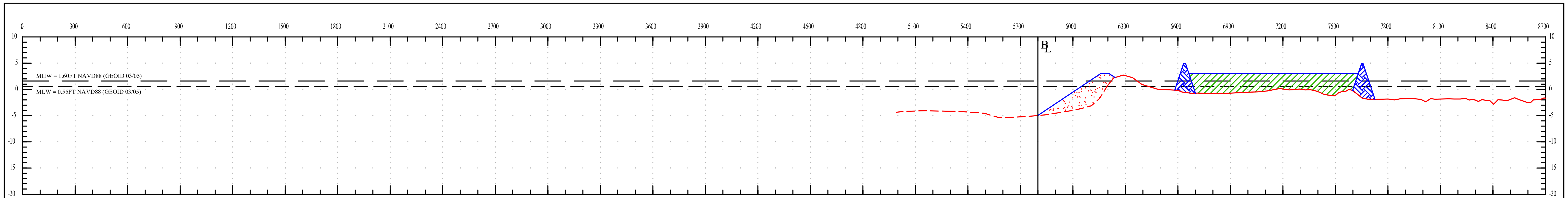
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

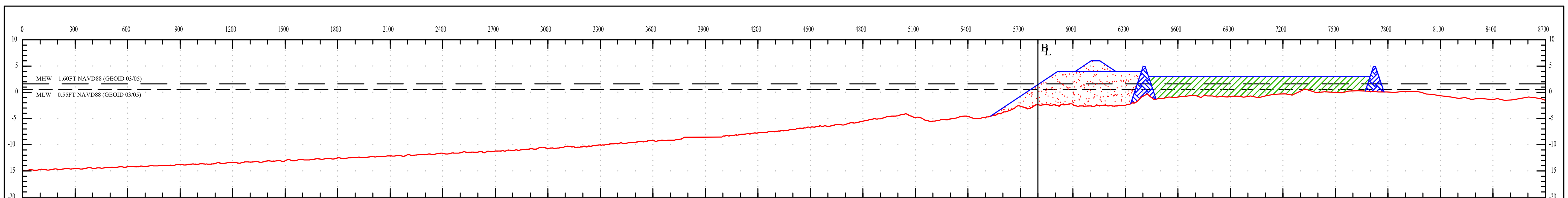
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

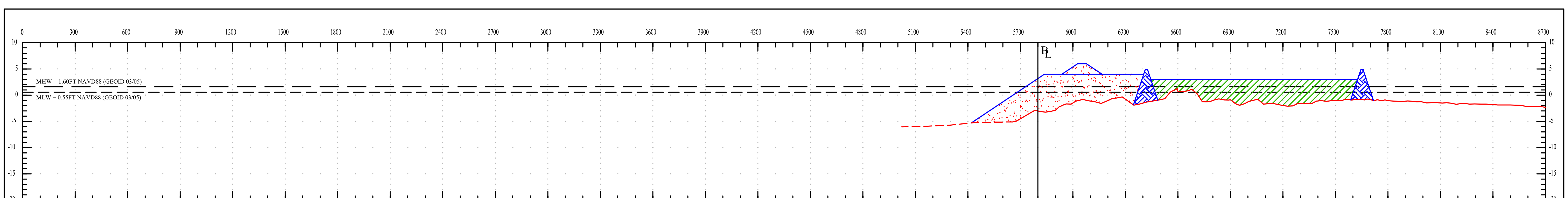
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 3 - STATION 35+00
DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 3 - STATION 45+00
DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 3 - STATION 55+00
DISTANCE ALONG BASELINE (FT)



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FIGURE 5-9: SCOFIELD ISLAND ALTERNATIVE 3
CROSS SECTIONS


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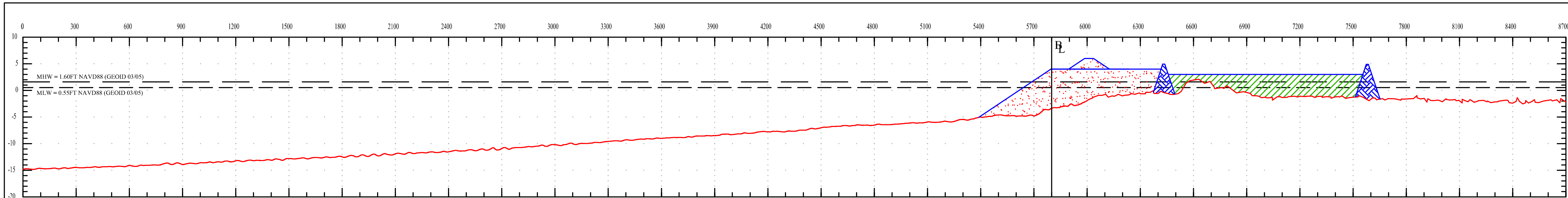
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

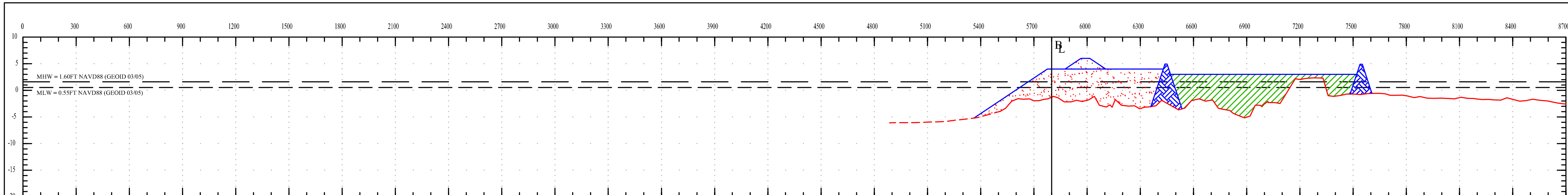
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

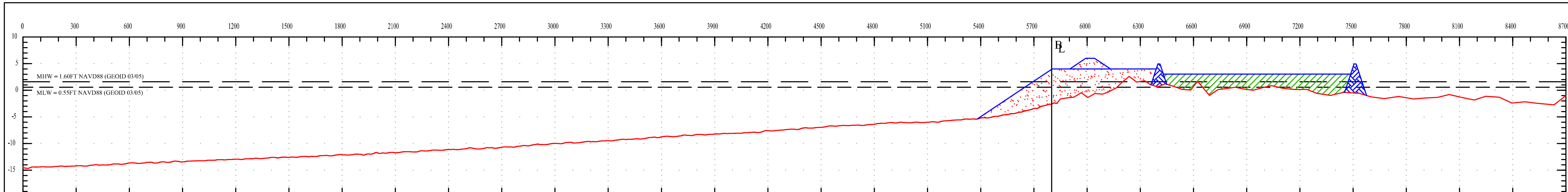
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 3 - STATION 65+00 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 3 - STATION 75+00 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 3 - STATION 85+00 DISTANCE ALONG BASELINE (FT)

BEACH / DUNE FILL

MARSH FILL

CONTAINMENT DIKE

2008 SURVEY

2008 INTERPOLATED SURVEY

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FIGURE 5-10: SCOFIELD ISLAND ALTERNATIVE 3
CROSS SECTIONS

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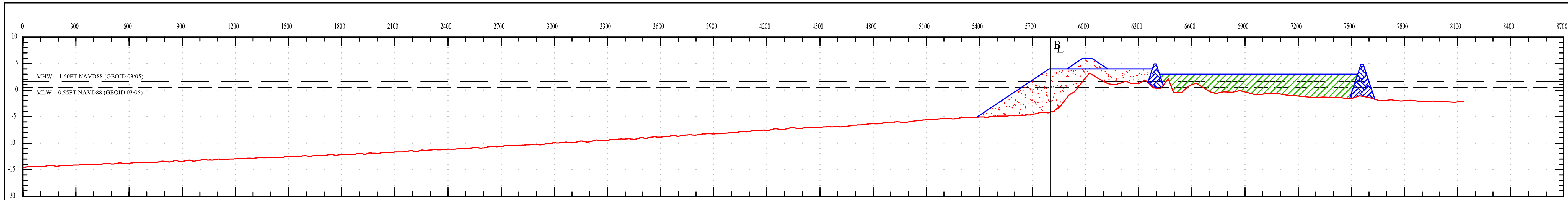
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

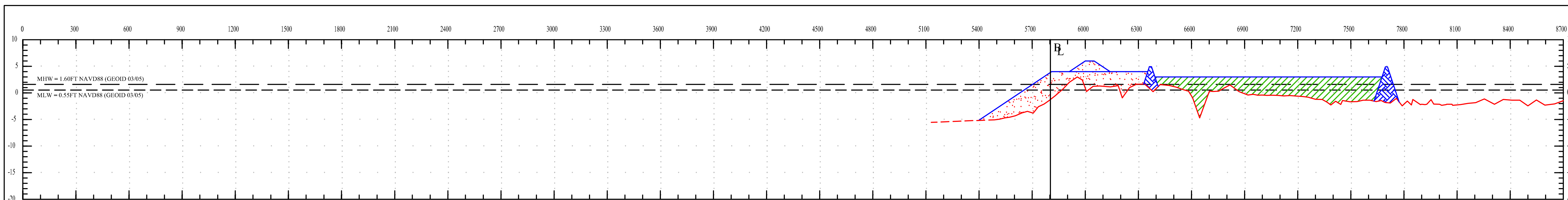
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

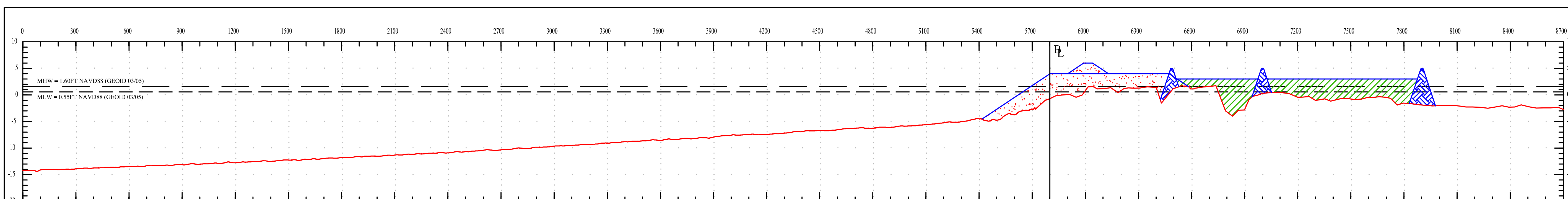
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 3 - STATION 88+15 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 3 - STATION 95+00 DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 3 - STATION 105+00 DISTANCE ALONG BASELINE (FT)

BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY

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FIGURE 5-11: SCOFIELD ISLAND ALTERNATIVE 3
CROSS SECTIONS

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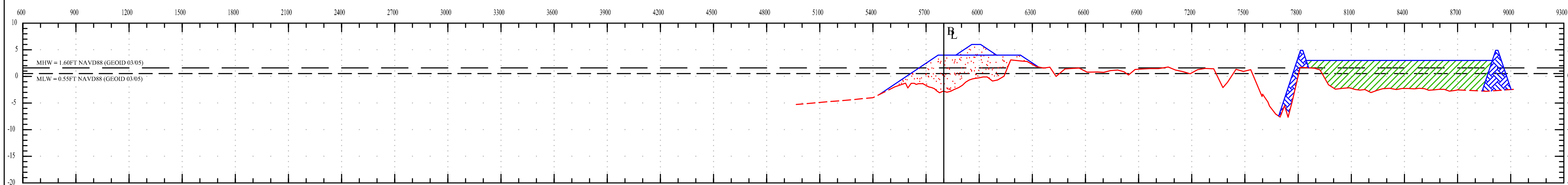
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

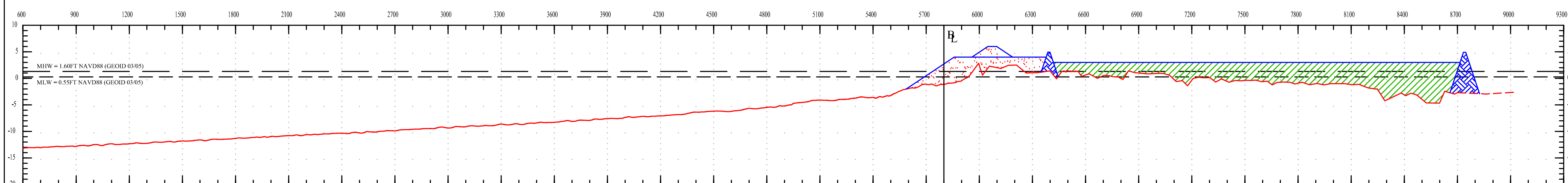
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

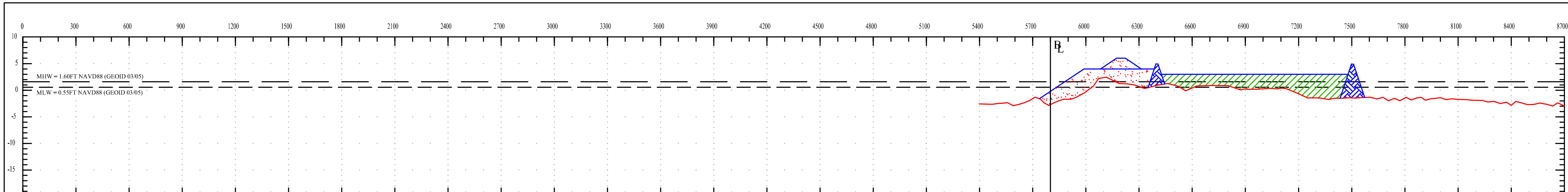
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 3 - STATION 115+00
DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 3 - STATION 125+00
DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 3 - STATION 135+00
DISTANCE ALONG BASELINE (FT)

BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY

FIGURE 5-12: SCOFIELD ISLAND ALTERNATIVE 3
CROSS SECTIONS

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## 5.5 Alternative 4

This alternative is designed to provide an approximate 10,600 foot long beach and dune fill. The gulfward limits of the beach fill are approximately aligned with the current shoreline position thus the majority of the existing island framework is covered by the proposed beach and dune fill. The dune component includes a 200 foot wide crest width at +6 feet NAVD88 with 1:45 side slopes. The beach fill template includes a variable width, 340 feet to 440 feet wide, construction berm that extends from the Gulf side beach fill crest to the Gulf side toe of the dune at +4 feet NAVD88 with 1:45 side slopes. The elevations were chosen to correspond to storm surge levels between the 5- and 10-year storm events to minimize overtopping into the marsh. The average beach fill width measured at MHW is approximately 950 feet. The area of the proposed beach platform is approximately 267 acres measured at +4 feet NAVD88. The required fill volume is approximately 2.03 million cubic yards including the preliminary design criteria for the overfill ratio and two years of background erosion equal to the gulf-side erosion less the overwash. The required excavation volume including the preliminary design criteria for the cut to fill ratio is approximately 2.64 million cubic yards. The average beach and dune fill density for Alternative 4 is 196.8 cubic yards per linear foot along the island.

This alternative is also designed to provide an approximately 12,000 foot long by 1,100 foot wide marsh platform on the bay side of Scofield Island. The marsh is also placed west of the beach fill on the west end of the island. The area of the proposed marsh platform is approximately 299 acres. The target marsh platform elevation is +3.0 feet NAVD88 accounting for the preliminary design criteria on average existing marsh elevation, sea level rise, subsidence and consolidation. The required fill volume is approximately 1.88 million cubic yards. The required excavation volume including the preliminary design criteria for the cut to fill ratio is approximately 3.01 million cubic yards. The average marsh fill density for Alternative 4 is 153.1 cubic yards per linear foot along the marsh platform.

A plan view for Alternative 4 is presented in Figure 5-13. The Alternative 4 cross-sections are presented in Figures 5-14 through 5-18.

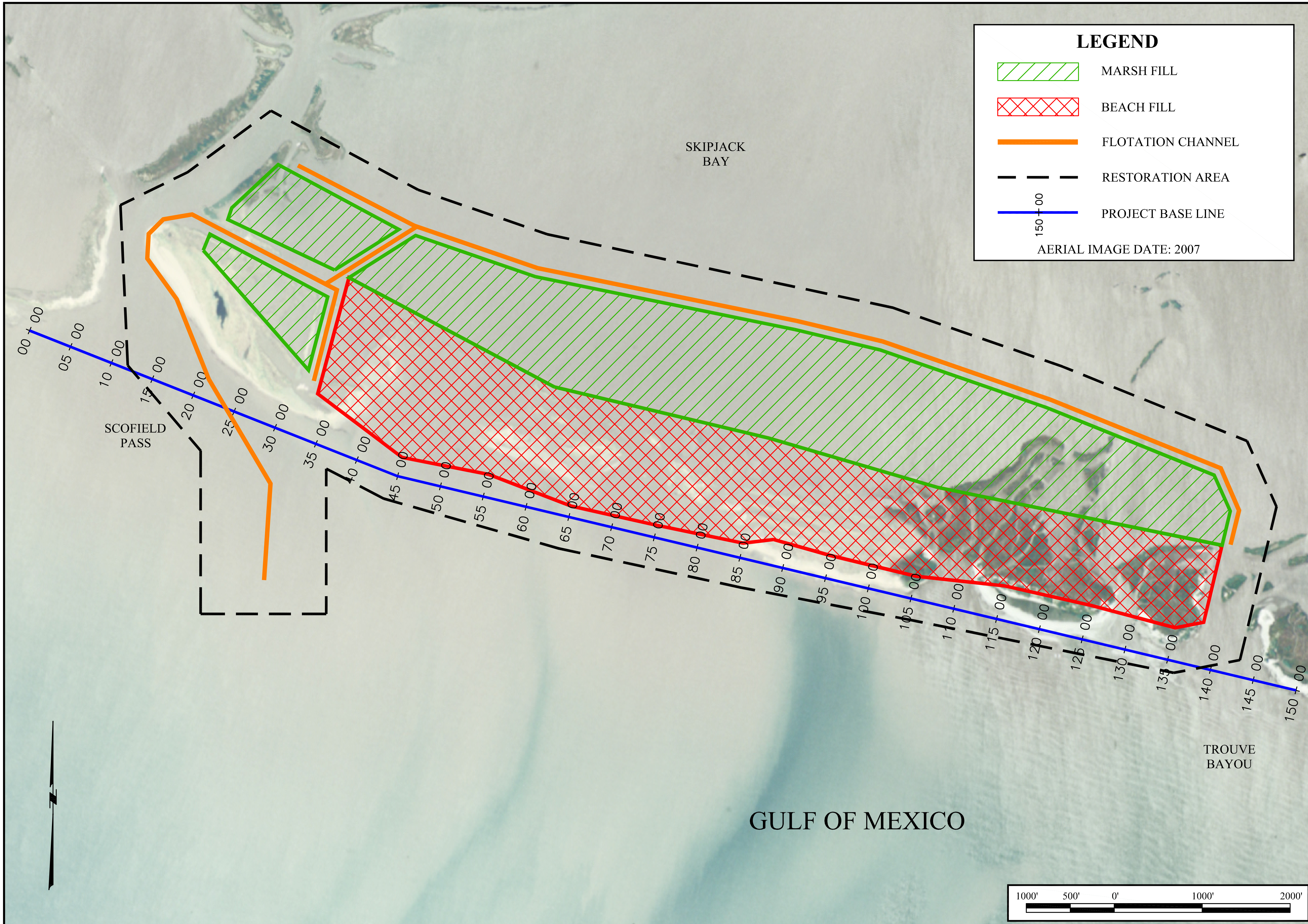


FIGURE 5-13: SCOFIELD ISLAND ALTERNATIVE 4
PLAN VIEW

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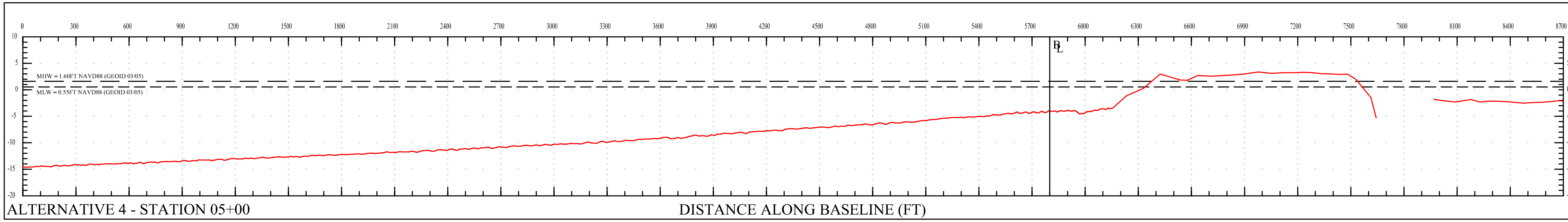
SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

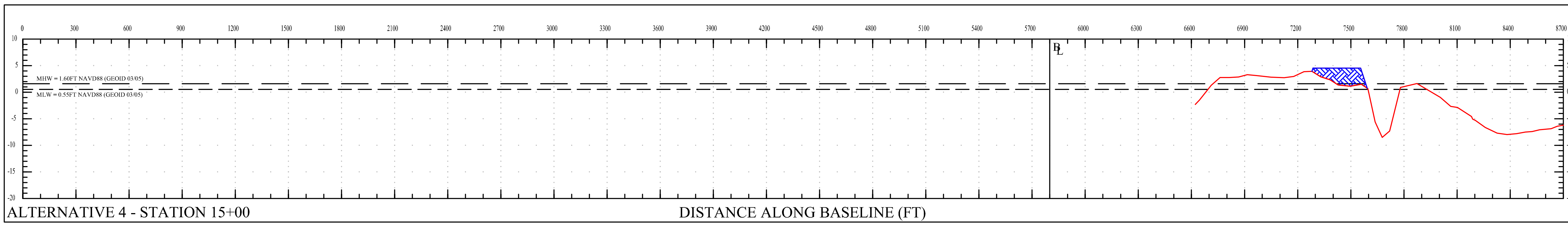
# PRELIMINARY DESIGN PARAMETERS

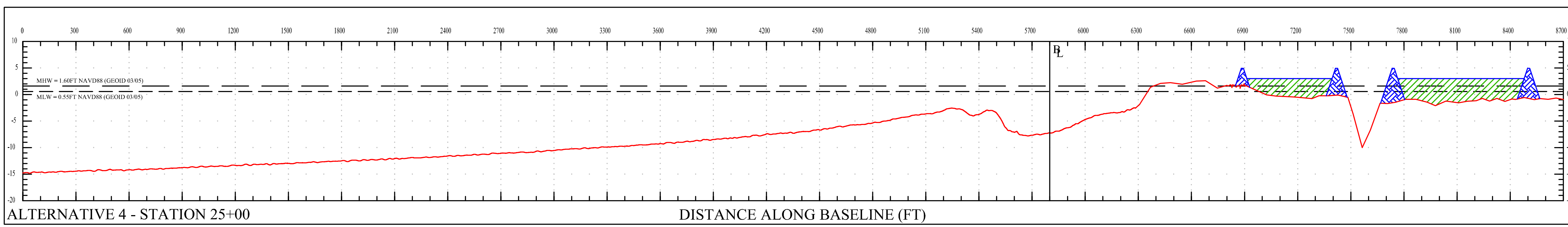
SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY

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# FIGURE 5-14: SCOFIELD ISLAND ALTERNATIVE 4 CROSS SECTIONS

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SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

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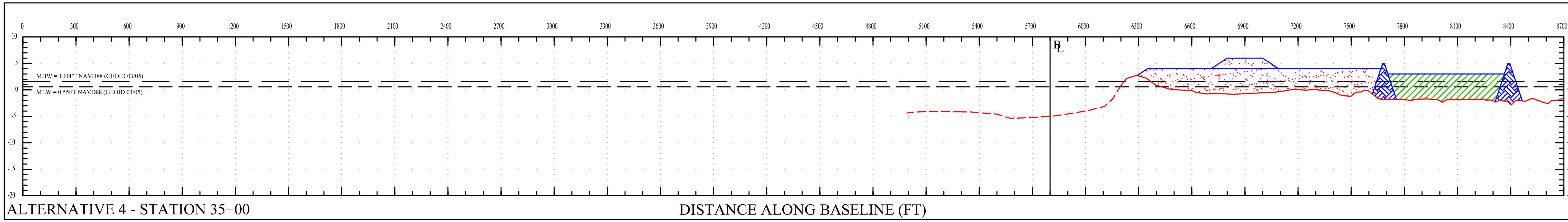
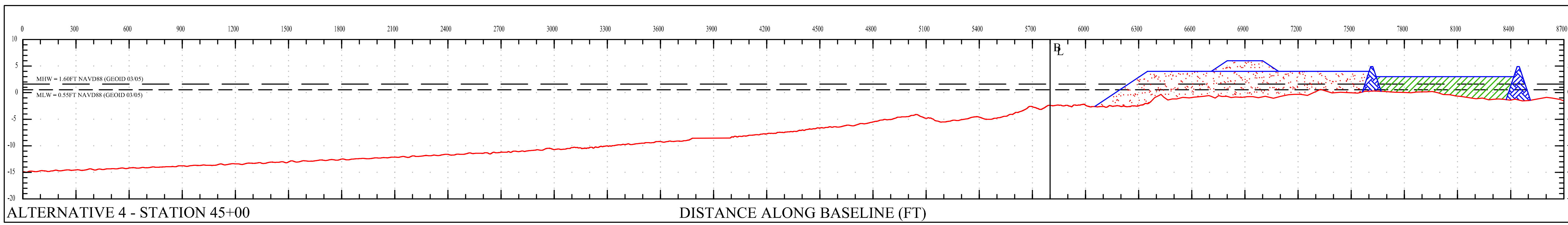
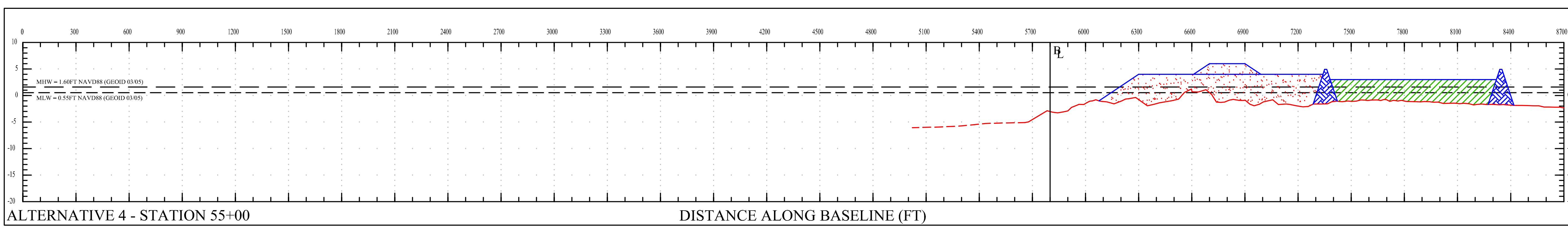
DUNE CROWN WIDTH: 200 FT

MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




BEACH / DUNE FILL — MARSH FILL — CONTAINMENT DIKE — 2008 SURVEY — 2008 INTERPOLATED SURVEY

FIGURE 5-15: SCOFIELD ISLAND ALTERNATIVE 4
CROSS SECTIONS

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SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

SCALE: H: 1" = 600
V: 1" = 20'

BEACH ELEVATION: +4.0 FT NAVD88
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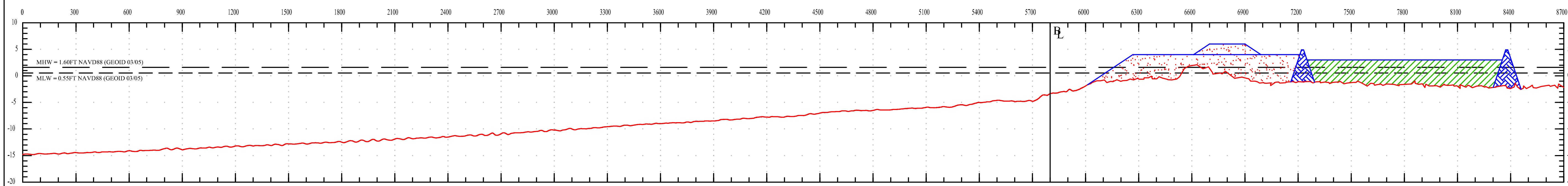
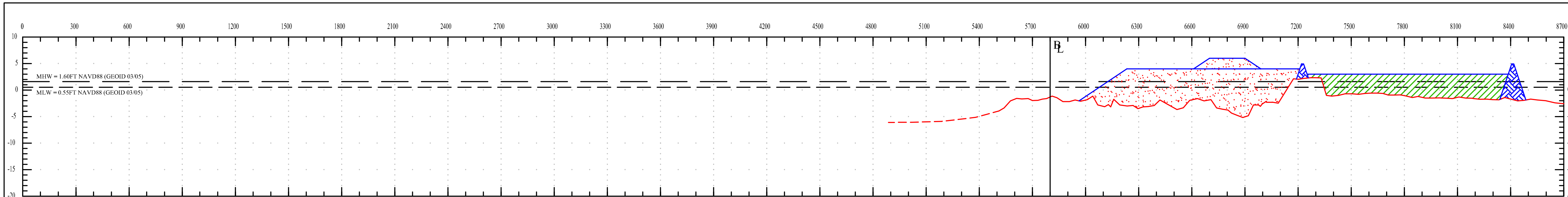
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

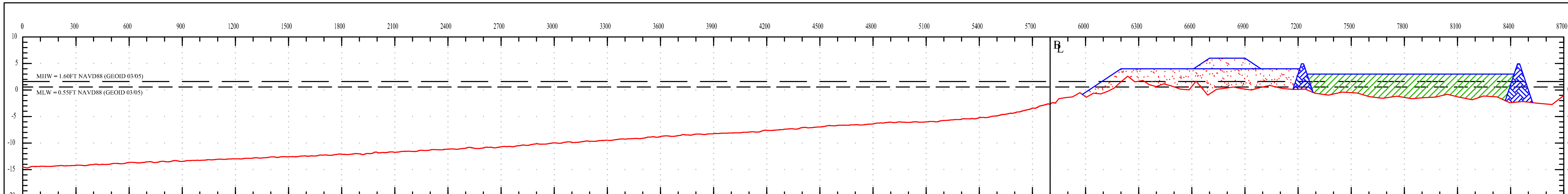
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT



ALTERNATIVE 4 - STATION 65+00



ALTERNATIVE 4 - STATION 75+00



ALTERNATIVE 4 - STATION 85+00

BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY

FIGURE 5-16: SCOFIELD ISLAND ALTERNATIVE 4
CROSS SECTIONS

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SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

SCALE: H: 1" = 600
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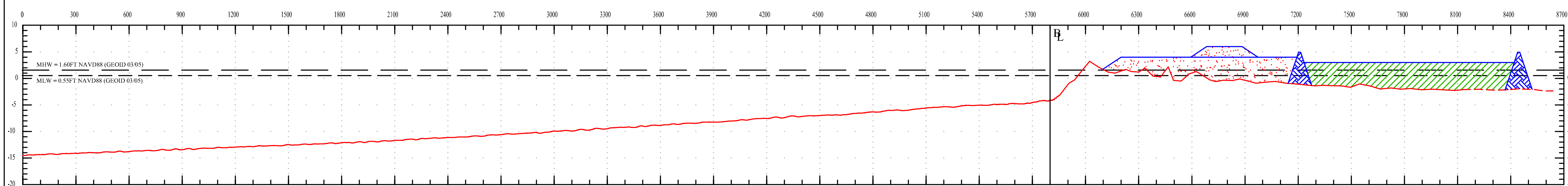
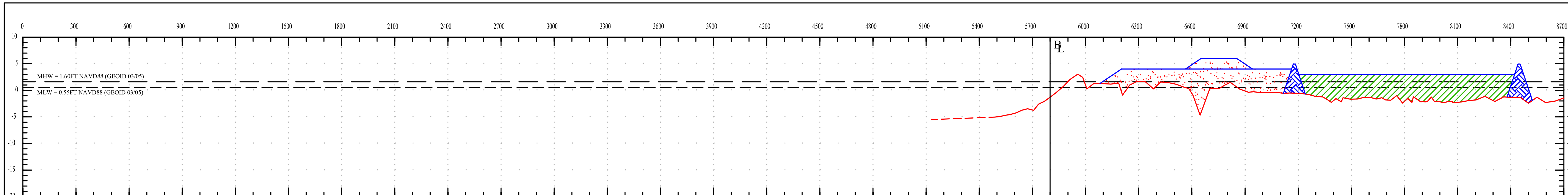
BEACH ELEVATION: +4.0 FT NAVD88
BEACH FACE SLOPE: 1V:45H
DUNE ELEVATION: +6.0 FT NAVD88
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

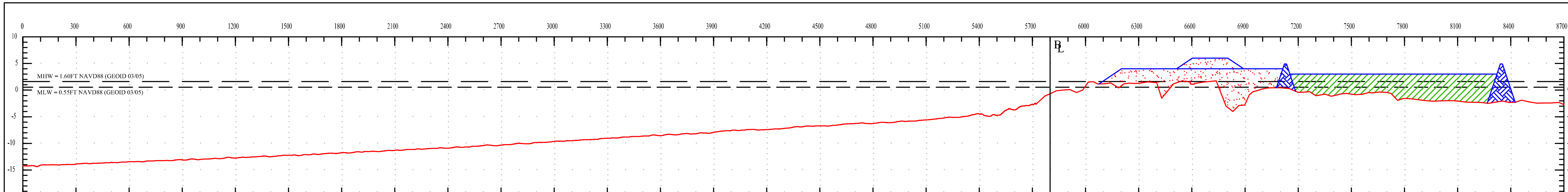
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 4 - STATION 88+15
DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 4 - STATION 95+00
DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 4 - STATION 105+00
DISTANCE ALONG BASELINE (FT)

BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY


COASTAL ENGINEERING CONSULTANTS INC.
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NAPLES, FLORIDA 34104


## FIGURE 5-17: SCOFIELD ISLAND ALTERNATIVE 4 CROSS SECTIONS


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SCOFIELD ISLAND SURVEY 2008
NAD83 STATE PLANE LA-SOUTH - FEET
NAVD88 (GEOID 03/05), U.S. SURVEY FEET

# PRELIMINARY DESIGN PARAMETERS

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V: 1" = 20'

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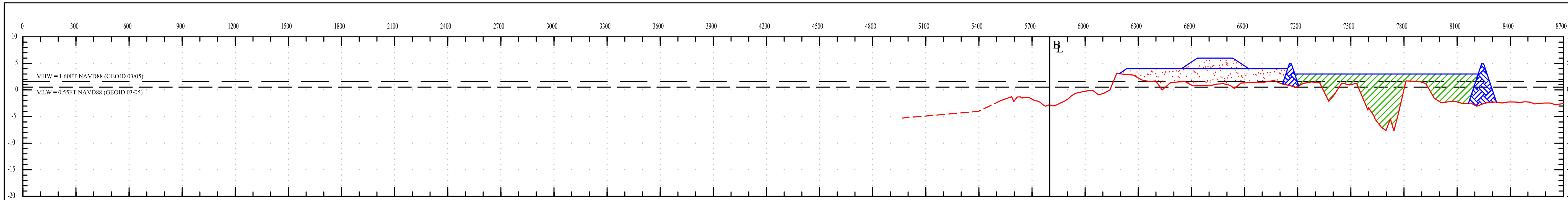
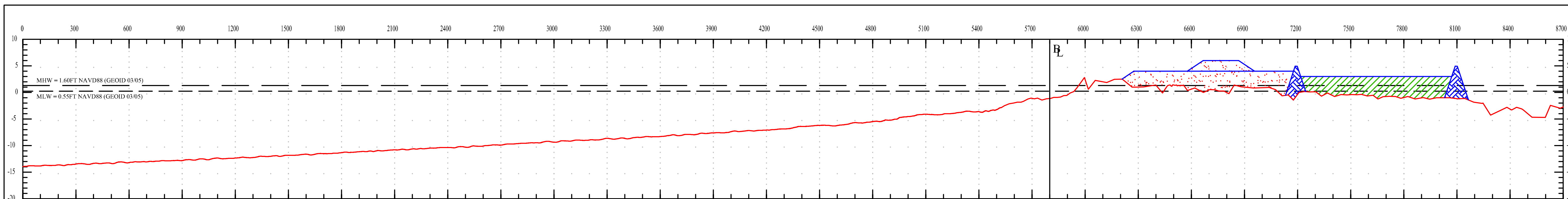
DUNE FACE SLOPE: 1V:45H
DUNE CROWN WIDTH: 200 FT

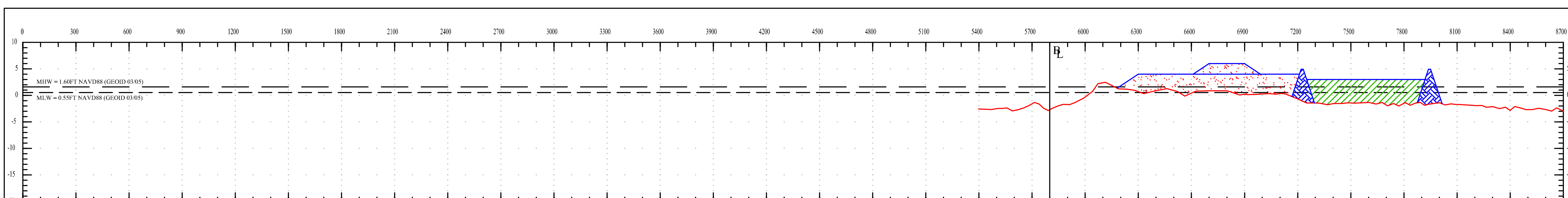
MARSH ELEVATION: +3.0 FT NAVD88
DIKE ELEVATION: +4.9 FT NAVD88
DIKE FACE SLOPE: 1V:8H
DIKE CROWN WIDTH: 10 FT




ALTERNATIVE 4 - STATION 115+00
DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 4 - STATION 125+00
DISTANCE ALONG BASELINE (FT)




ALTERNATIVE 4 - STATION 135+00
DISTANCE ALONG BASELINE (FT)

BEACH / DUNE FILL
MARSH FILL
CONTAINMENT DIKE
2008 SURVEY
2008 INTERPOLATED SURVEY


COASTAL ENGINEERING CONSULTANTS INC.
PH: (239) 643-2324
FAX: (239) 643-1143
3106 SOUTH HORSESHOE DRIVE
NAPLES, FLORIDA 34104


FIGURE 5-18: SCOFIELD ISLAND ALTERNATIVE 4
CROSS SECTIONS


SJB GROUP, LLC
QUALITY BY DESIGN
P.O. BOX 1751
BATON ROUGE, LA. 70821
PHONE (225) 769-3400
FAX (225) 769-3596

## 5.6 Summary

Alternative 1 was excluded from further consideration as it does not meet any of the design objectives. Alternatives 2 through 4 are summarized in Table 5-1.

**Table 5-1: Summary of Alternatives**

| **Required Volumes / Acres Created** | **ALT-2** Volumes (mcy) / Acres | **ALT-3** Volumes (mcy) / Acres | **ALT-4** Volumes (mcy) / Acres |
|---|---|---|---|
| Marsh Fill Total (includes overfill & cut-to-fill ratios*) | 2.79 / 375 | 2.82 / 319 | 3.01 / 299 |
| Beach / Dune Fill Total (includes overfill & cut-to-fill ratios**) | 2.64 / 223 | 2.24 $myd^3$ / 221 | 2.64 $myd^3$ / 267 |
| Overall Totals | 5.43 / 598 | 5.06 $myd^3$ / 540 | 5.65 $myd^3$ / 566 |
| **Fill Densities** | **ALT-2** (cy/foot) | **ALT-3** (cy/foot) | **ALT-4** (cy/foot) |
| Marsh Fill | 150.3 | 151.9 | 153.1 |
| Beach / Dune Fill | 176.8 | 150.0 | 196.8 |
| **Containment Dikes** | **ALT-2** Approx. Linear Feet / Approx. Volume (cy) | **ALT-3** Approx. Linear Feet / Approx. Volume (cy) | **ALT-4** Approx. Linear Feet / Approx. Volume (cy) |
| Marsh Containment Dikes | 16,910 / 350,550 | 17,890 / 370,820 | 20,270 / 420,200 |
| Beach / Marsh Separation Dikes | 11,670 / 159,630 | 10,230 / 139,900 | 11,820 / 161,700 |
| **Access Channel** | **ALT-2** | **ALT-3** | **ALT-4** |
| Approx. Linear Feet | 20,080 | 20,920 | 21,020 |

* volumes are based on 1.3 cut to fill ratio
** volumes are based on 1.6 cut to fill ratio

## 6.0 ALTERNATIVES ANALYSIS

The Preliminary Design Phase developed four (4) alternatives for marsh, beach and dune restoration to achieve the Project's design objectives. Because Alternative 1 "No Action" does not meet any of the Project's design objectives, it was not considered for the recommended plan. The following parameters were evaluated for the Alternatives 2 through 4 to determine the optimal balance among the parameters leading to the recommended plan.

- Storm Protection Benefits
- Environmental Habitat Creation and Sustainability
- Land Loss Over Time
- Fiscal

### 6.1 Storm Protection Benefits

#### 6.1.1 Model Description

##### 6.1.1.1 Software Description

One of the considerations in designing alternatives for restoring the beach, dune, and marsh along Scofield Island is how the fill material will adjust and equilibrate under various storm scenarios. In order to evaluate this aspect of the alternative designs, a cross-shore sediment transport model was conducted for various normal and storm conditions on the proposed alternative fill templates.

In order to help predict the erosion rates for the native beach profile and proposed fill templates, the Storm-Induced Beach Change Model SBEACH was used (Rosati, et.al., 1993). The version of SBEACH chosen is part of a package developed by Veri-Tech, Inc., called the Coastal Engineering Design and Analysis System, or CEDAS. Version 3.06 of CEDAS was used throughout the SBEACH analysis.

SBEACH is a two-dimensional model that simulates cross-shore transport of sediment due primarily to breaking waves and changing water levels. Longshore wave and current sediment transport is not accounted for by SBEACH. Water level changes are calculated from input wind, storm surge, and tide data.

##### 6.1.1.2 Grid Design

Each scenario was set up in SBEACH with the same grid cell layout. The bathymetric profiles were extracted from site data along three 8,700-foot transects at Stations 45+00, 65+00, and

105+00 on the survey baseline. These profiles represent survey data collected by CEC in 2008 as presented in Section 3.2.3. The grid defined along this cross-section, starting from the northern most end, consisted of 870 10-foot wide cells.

#### 6.1.1.3 Model Parameters and Calibration

No site specific data were available for calibration of the model. A sensitivity analysis was performed by varying the model parameters.

A transport rate coefficient (K) of $1.75 \times 10^{-6}$ $m^4/N$ was used. This coefficient can range from $2.5 \times 10^{-7}$ to $2.5 \times 10^{-6}$ $m^4/N$ in SBEACH. As the name implies, this parameter controls the amount of cross-shore transport that will occur under given forces. The sensitivity analysis showed that higher values cause a greater amount of sand transport to be modeled.

The coefficient for the slope-dependent term was set to 0.002 $m^2/s$ in the model. This coefficient can range from 0.001 to 0.005 $m^2/s$, and accounts for changes in the transport rate that occur due to changes in the slope of the bathymetric surface. Larger values of the coefficient will increase transport on sloped surfaces, which has the effect of subduing the development of sand bars in the simulation.

A transport rate decay coefficient multiplier of 0.5 was used in the model. This term can range from 0.1 to 0.5. Large values for this parameter cause the transport rate to decay more quickly seaward of the breaker line.

Two grain sizes, 0.13 mm and 0.24 mm, representing the range of grain sizes for MR-B-09 and MR-E-09 borrow areas, were used in the model.

Each alternative was evaluated for erosion under two (2) different storm scenarios. The storm scenarios included Hurricanes Katrina (2005), Rita (2005), Gustav (2008), and Ike (2008). These storms are presented in detail in Section 4.1.5. Because Katrina and Rita occurred within 25 days of each other and Gustav and Ike occurred within 11 days of each other, the hurricanes were combined into two events.

The Katrina-Rita storm was modeled for 861 hours. Figure 6-1 presents wave and water level time series used in SBEACH at the offshore boundary. The wave height and period time series were computed by propagating wave conditions from a location 6.5 miles southwest of WIS Station 132 (Section 4.1.5) to the seaward limits, which represent the SBEACH offshore boundary, of transects 45+00, 65+00 and 105+00 using the STWAVE wave model. The water level data were obtained from verified historical records at NOAA/NOS CO-OPS Station 8761724 located at the Coast Guard Station on Grand Isle. Figure 6-2 presents the corresponding wind speed and wind direction time series used in SBEACH. The wind data were obtained from the NOAA/NWS/NCEP operational ocean wave predictions based on the output from the WAVEWATCH III model (http://polar.ncep.noaa.gov/waves/index2.shtml). The peak wave height, water elevation, and wind speed were 9.0 feet, 6.0 feet, and 115 feet/second, respectively.

While a sensitivity analysis was performed by varying the model parameters, it yielded similar results when comparing and contrasting the performance of the three alternatives.

The Gustav-Ike storm was modeled for 522 hours. Figure 6-3 presents wave and water level time series used in SBEACH at the offshore boundary and Figure 6-4 presents the corresponding wind speed and wind direction time. The peak wave height, water elevation, and wind speed were 12.1 feet, 5.7 feet, and 71 feet/second, respectively.

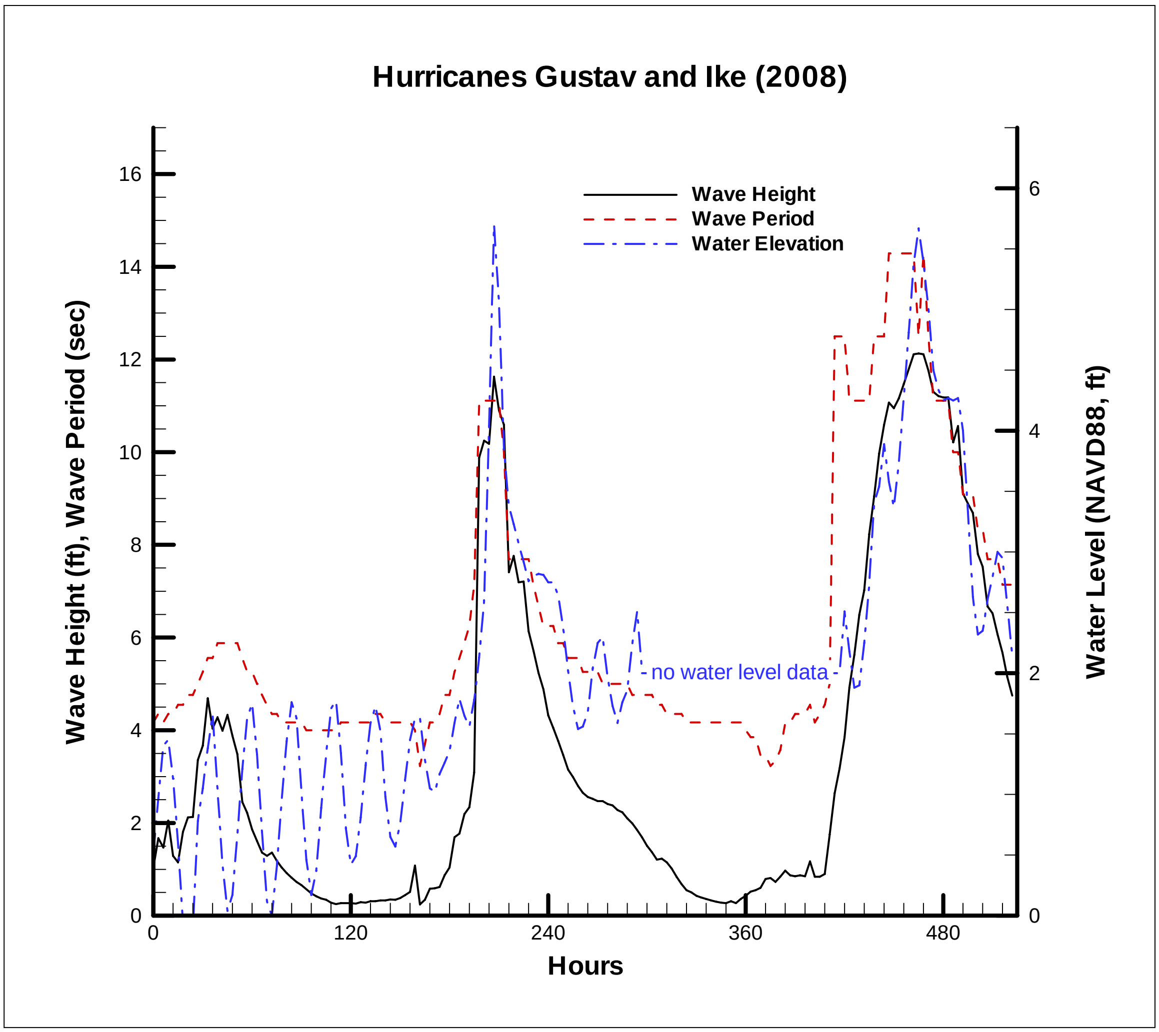



**Figure 6-1: Wave Parameters and Water Elevation Used in SBEACH During Simulation of Katrina-Rita Storm Event.**

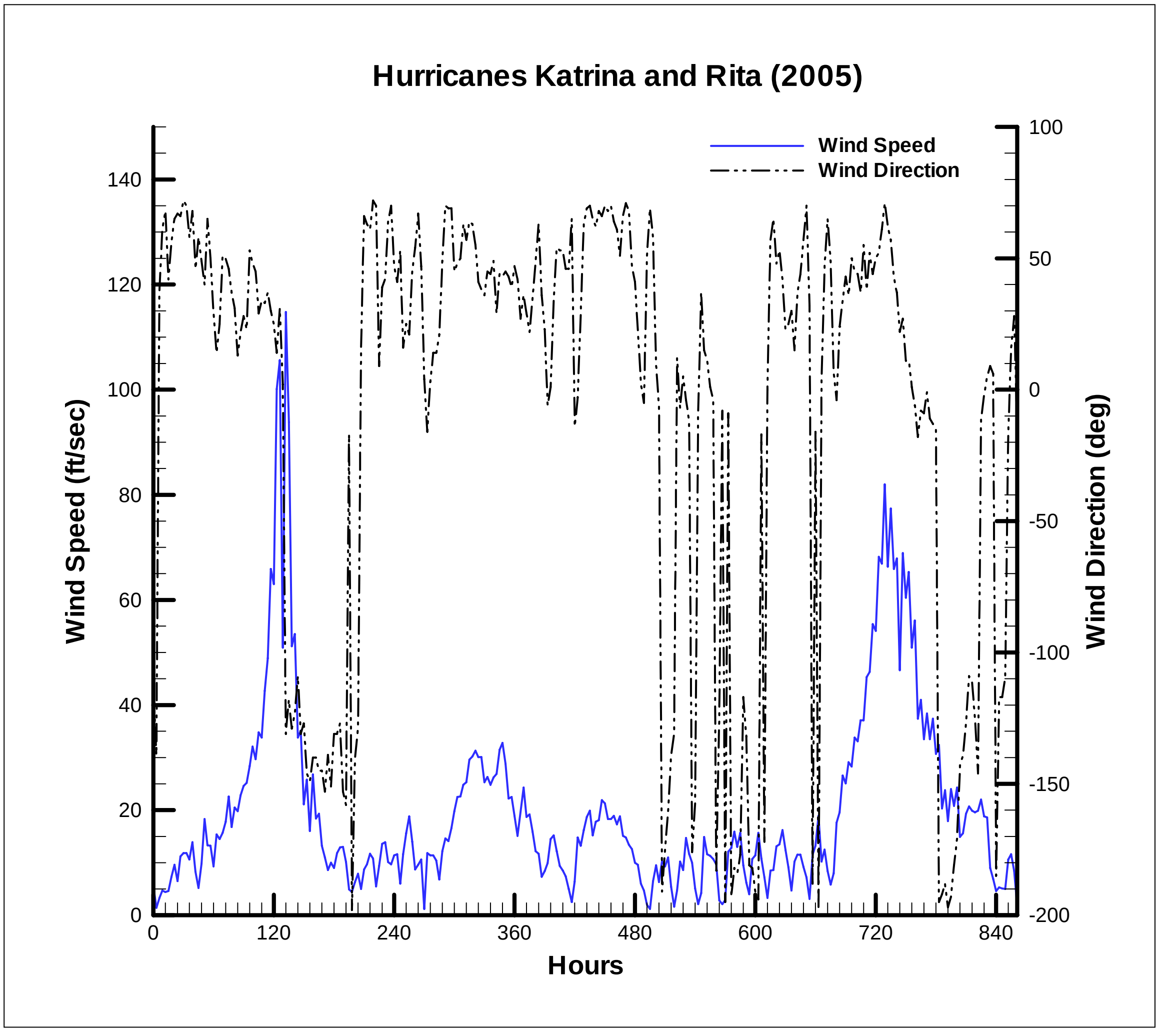



**Figure 6-2: Wind Speed and Wind Direction Used in SBEACH During Simulation of Katrina-Rita Storm Event.**

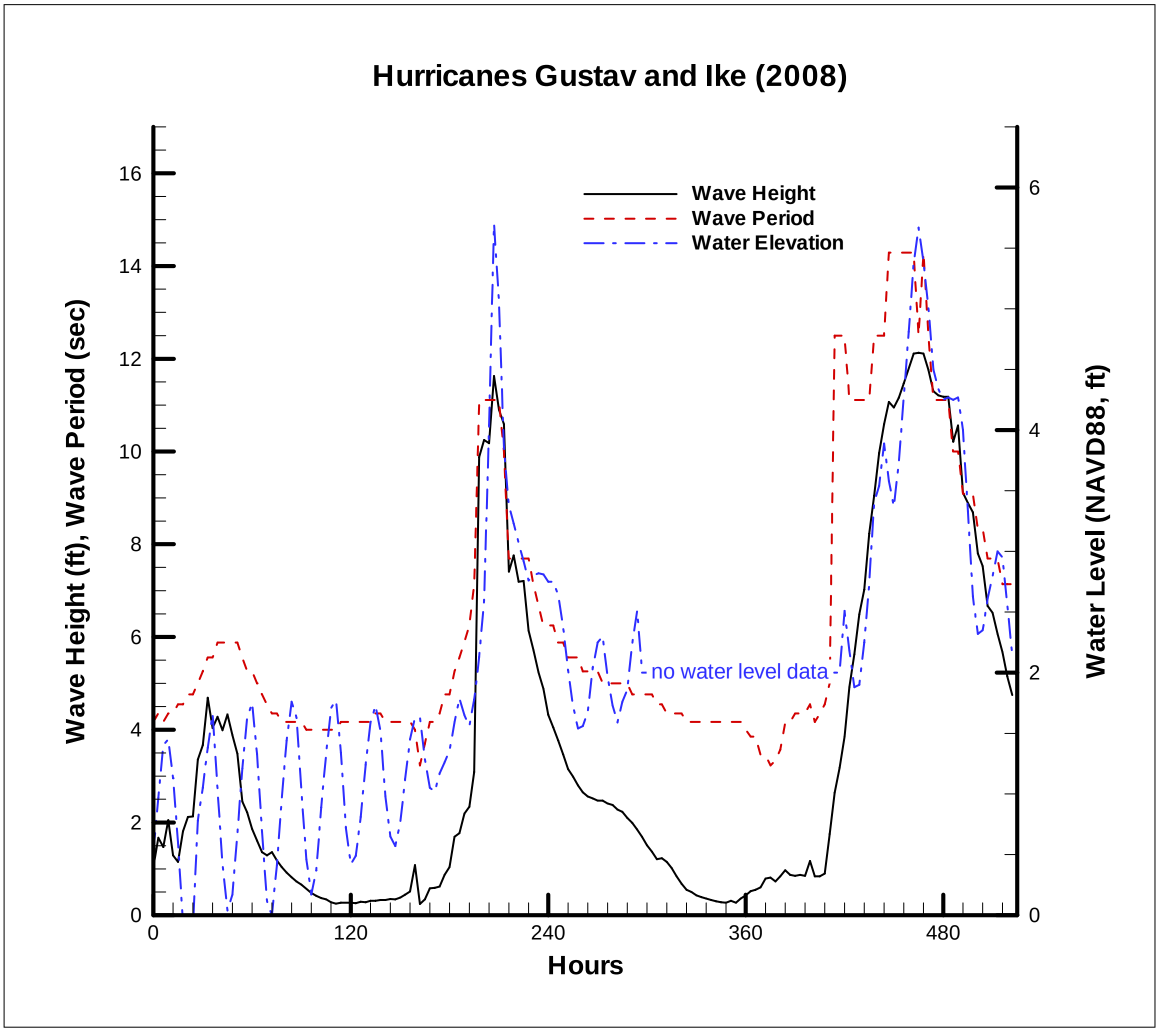



**Figure 6-3: Wave Parameters and Water Elevation used in SBEACH During Simulation of Gustav-Ike Storm Event.**

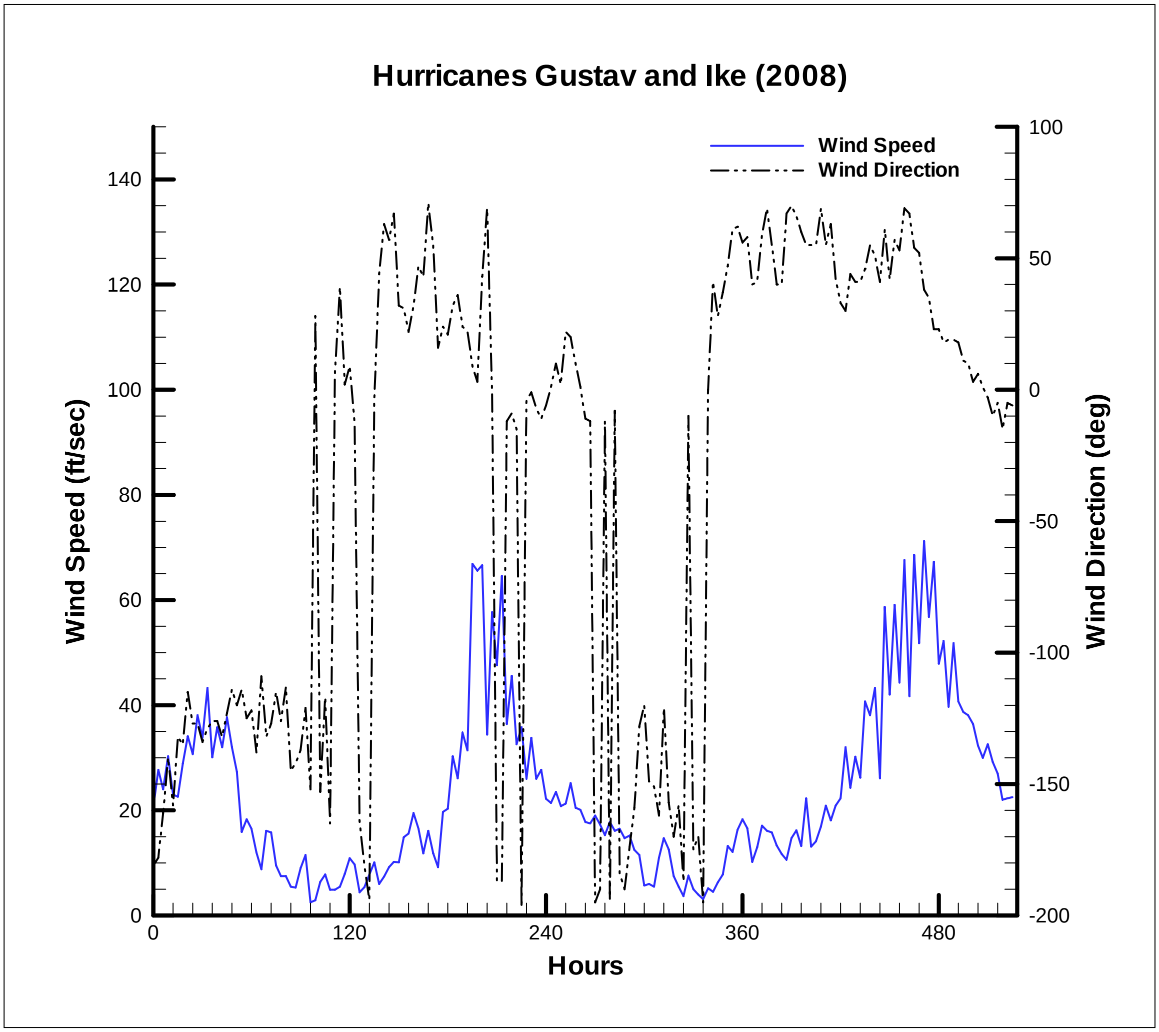



**Figure 6-4: Wind Speed and Wind Direction used in SBEACH During Simulation of Gustav-Ike Storm Event.**

For each storm scenario, a time step of 0.5 minutes was used.

### 6.1.2 Model Results

The model was run for the four (4) alternatives including the existing profile and three (3) proposed fill templates. A full description of each of the alternatives is provided in Section 5.0.

Figures 6-5 through 6-16 present initial and final SBEACH post-Katrina-Rita and post-Gustav-Ike profiles for all four alternatives along Transects 45+00, 65+00, and 105+00 using grain sizes of 0.13 mm and 0.24 mm.

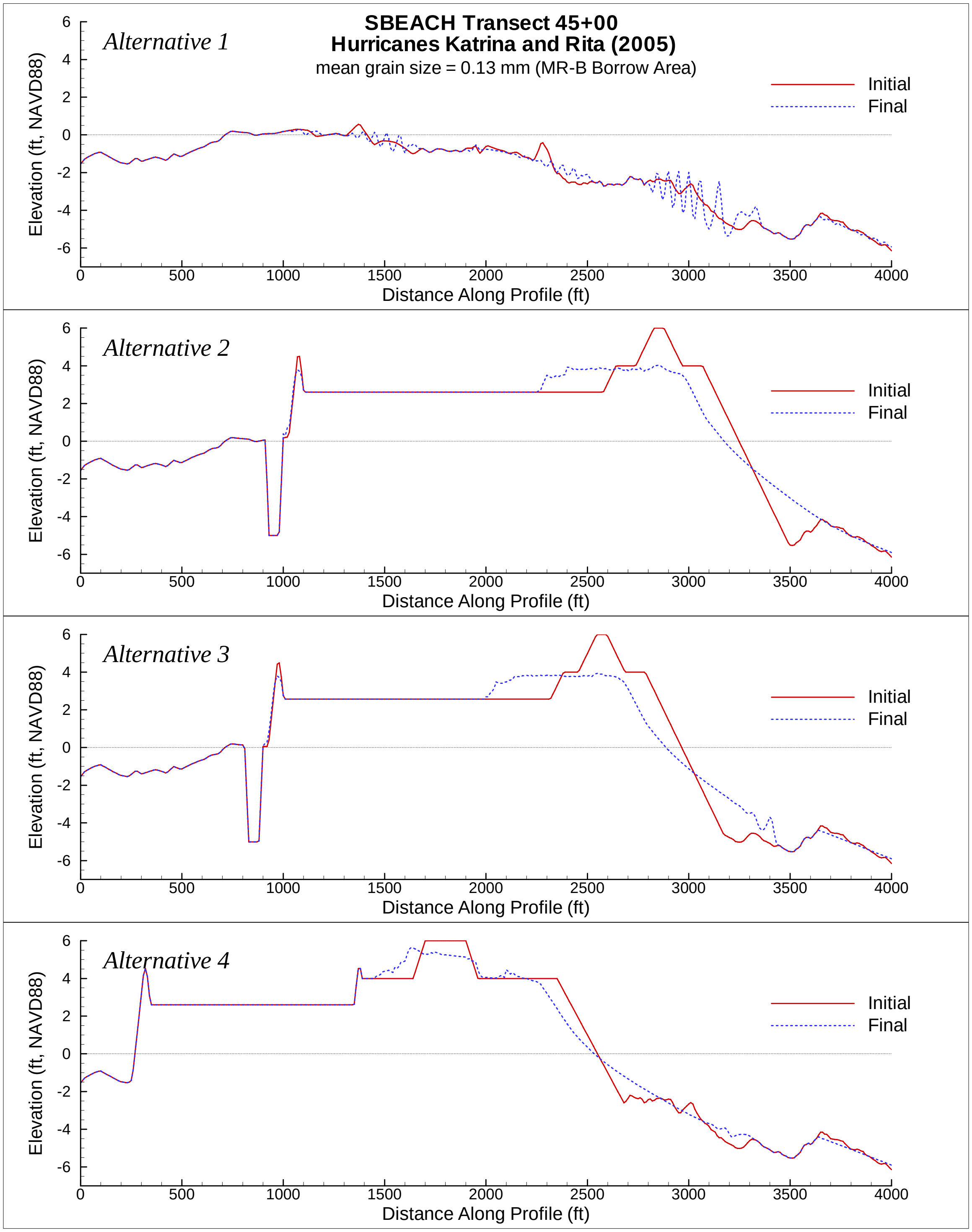



**Figure 6-5: Comparison Between Initial Beach Profile and Final Computed Post-Katrina-Rita, Beach Profiles for Alternatives 1 through 4 Along Transect 45+00 Using Mean Grain Size of 0.13 mm.**

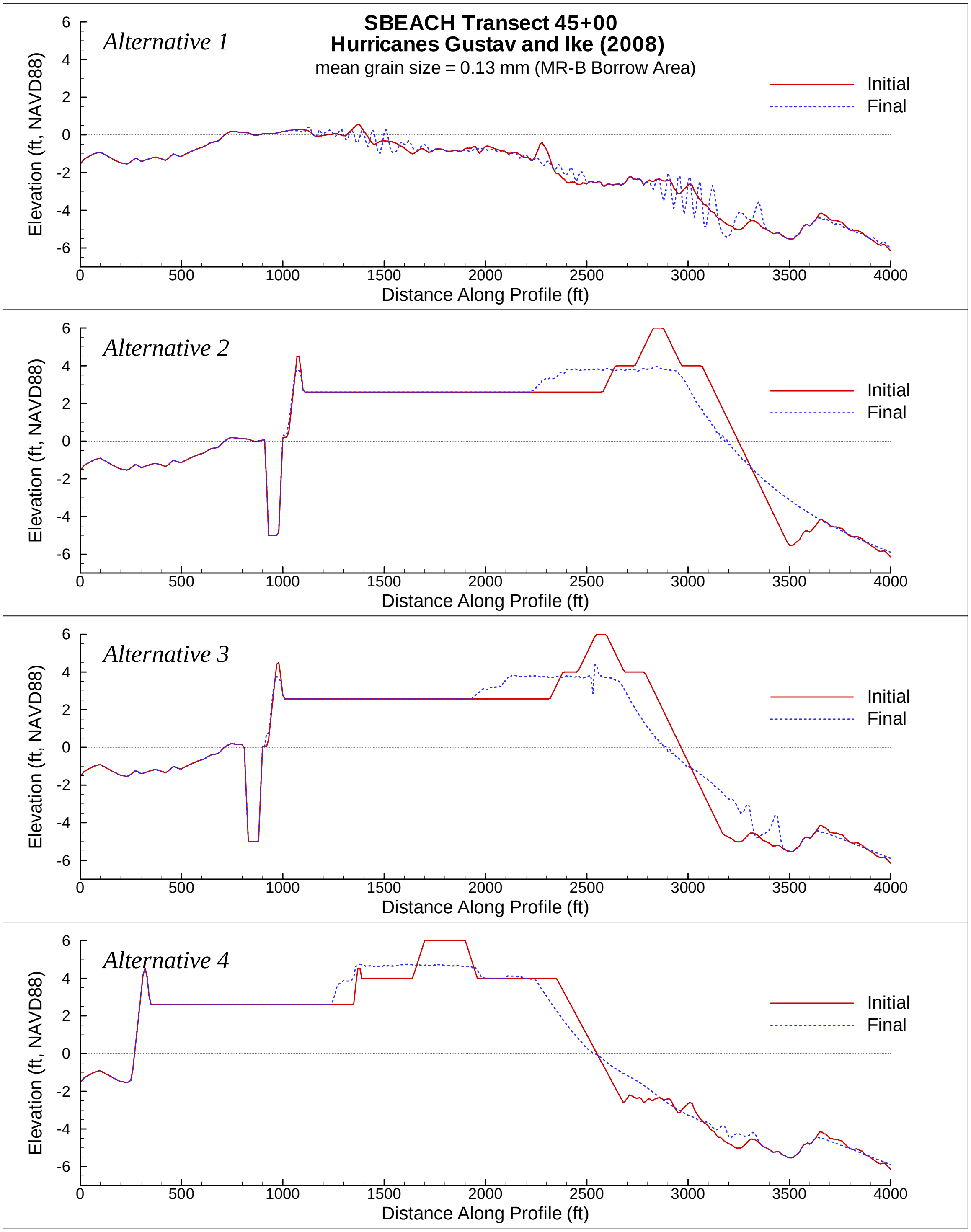



**Figure 6-6: Comparison Between Initial Beach Profile and Final Computed Post-Gustav-Ike, Beach Profiles for Alternatives 1 through 4 Along Transect 45+00 Using Mean Grain Size of 0.13 mm.**

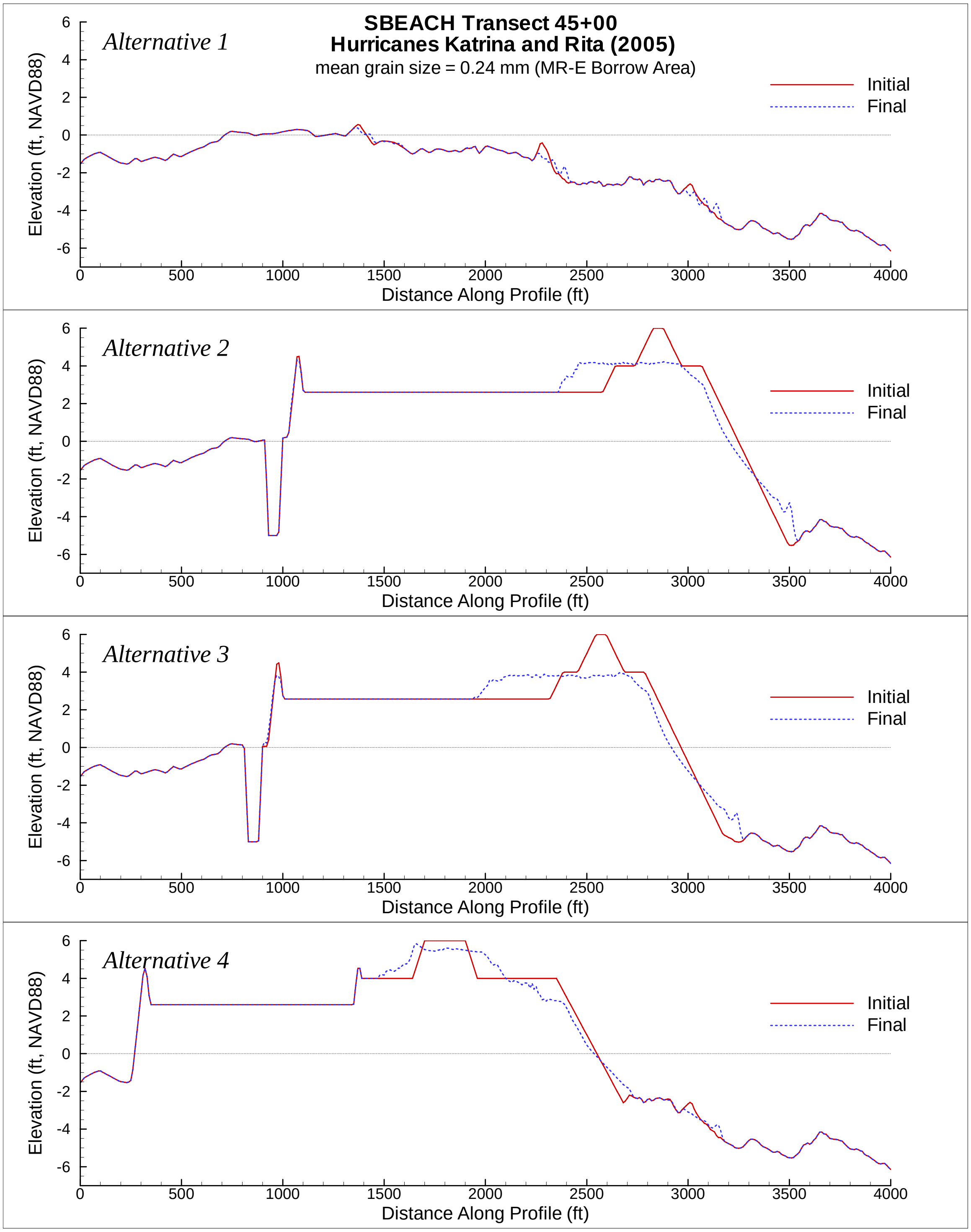



**Figure 6-7: Comparison Between Initial Beach Profile and Final Computed Post-Katrina-Rita, Beach Profiles for Alternatives 1 through 4 Along Transect 45+00 Using Mean Grain Size of 0.24 mm.**

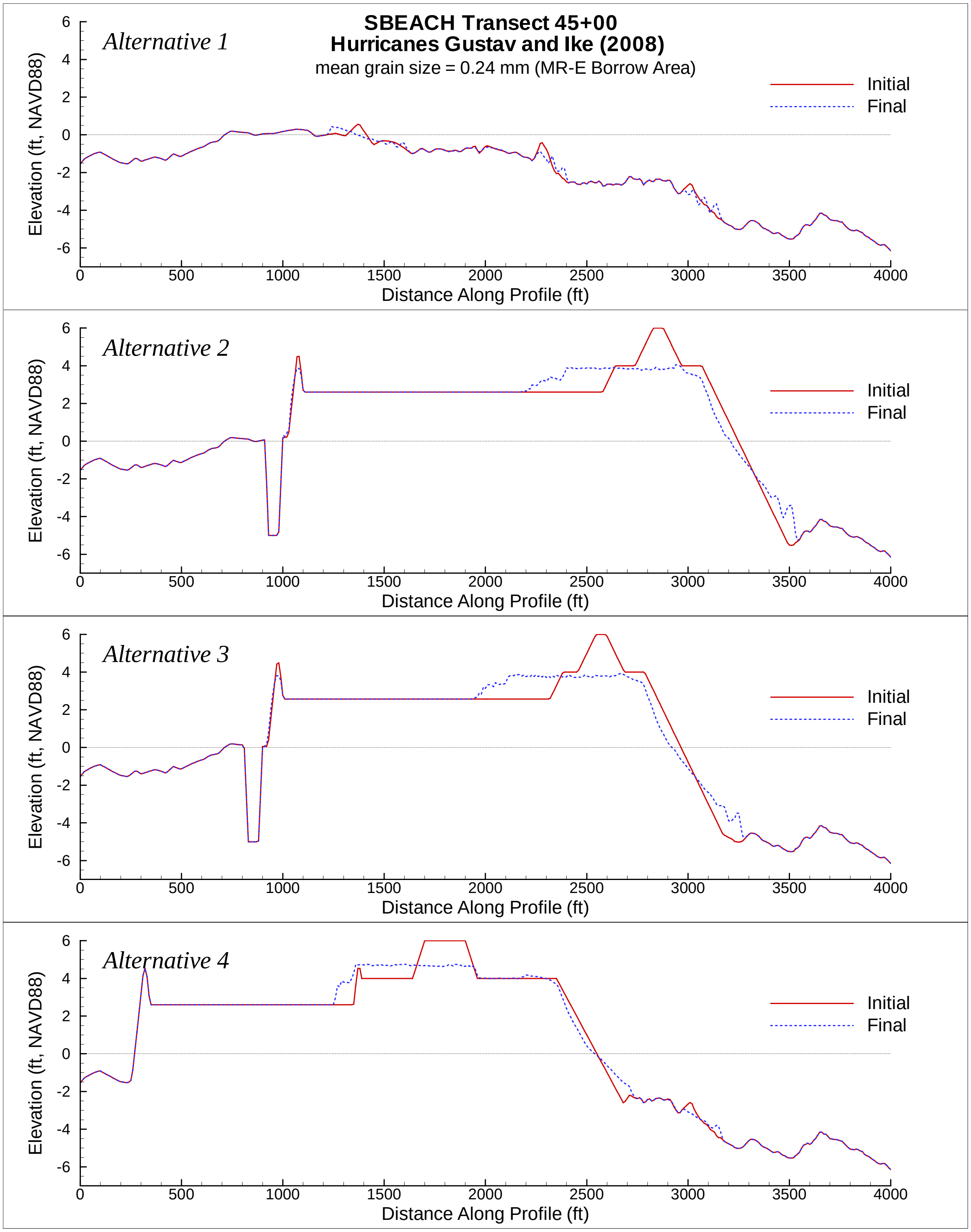



**Figure 6-8: Comparison Between Initial Beach Profile and Final Computed Post-Gustav-Ike, Beach Profiles for Alternatives 1 through 4 Along Transect 45+00 Using Mean Grain Size of 0.24 mm.**

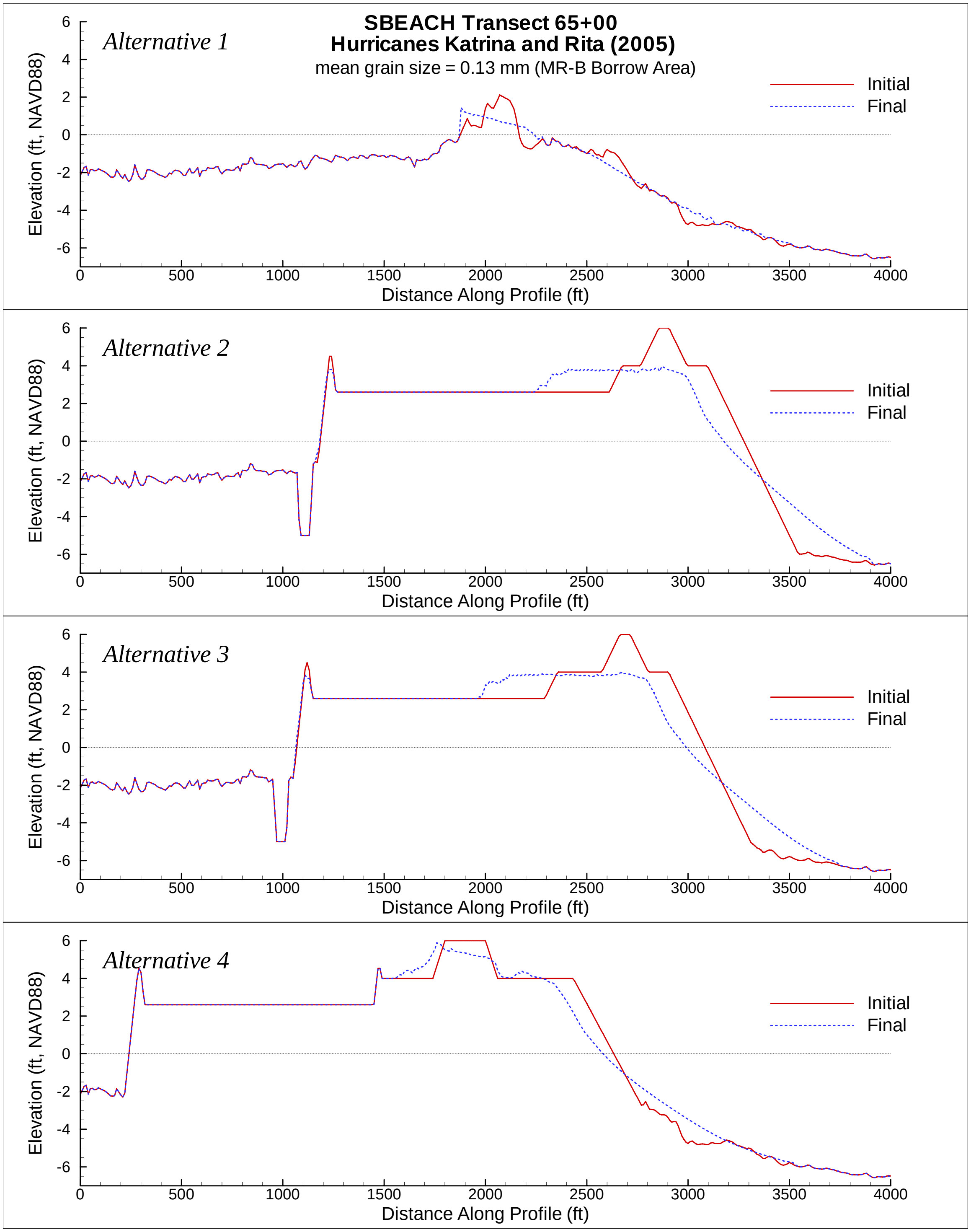



**Figure 6-9: Comparison Between Initial Beach Profile and Final Computed Post-Katrina-Rita, Beach Profiles for Alternatives 1 through 4 Along Transect 65+00 Using Mean Grain Size of 0.13 mm.**

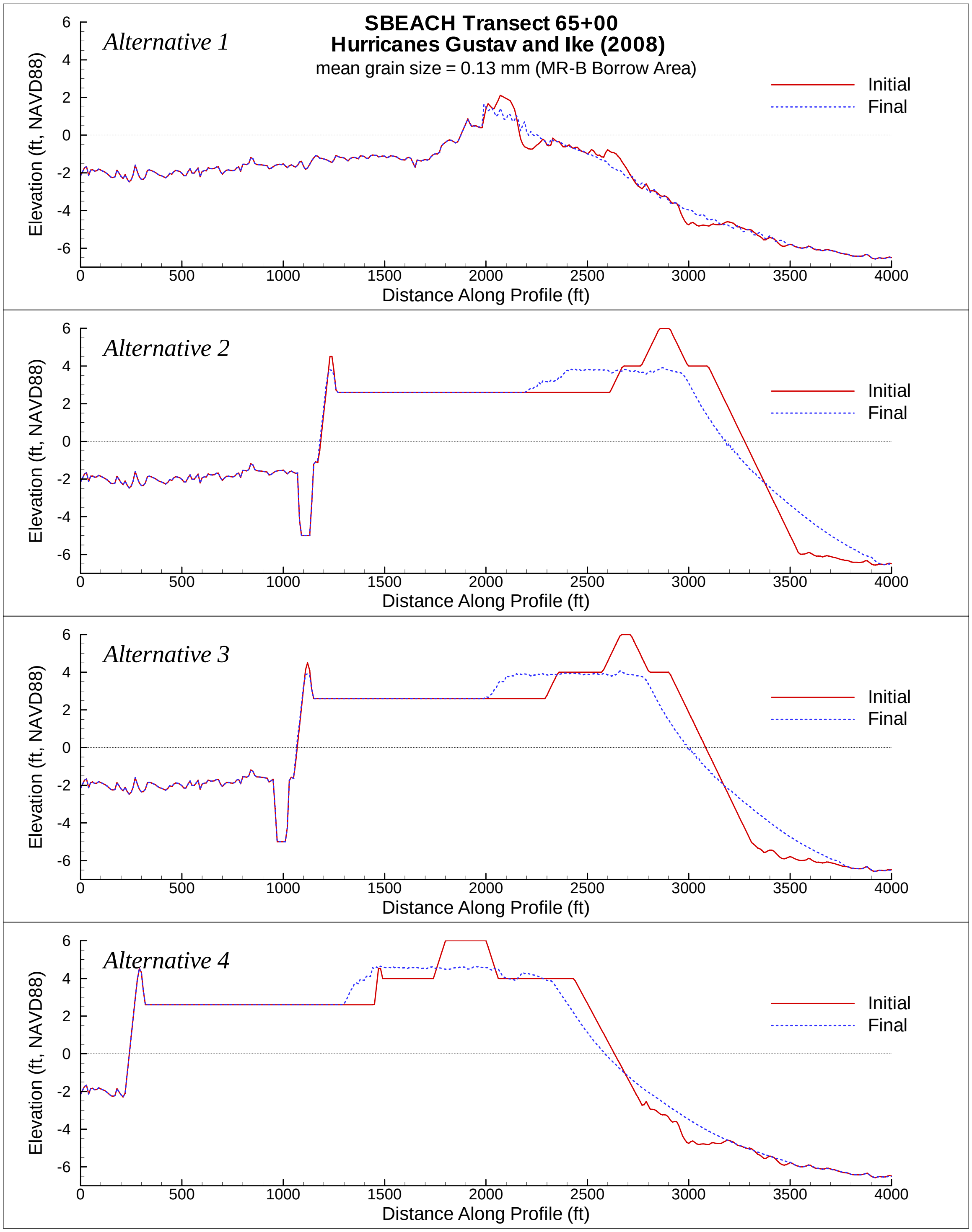



**Figure 6-10: Comparison Between Initial Beach Profile and Final Computed Post-Gustav-Ike, Beach Profiles for Alternatives 1 through 4 Along Transect 65+00 Using Mean Grain Size of 0.13 mm.**

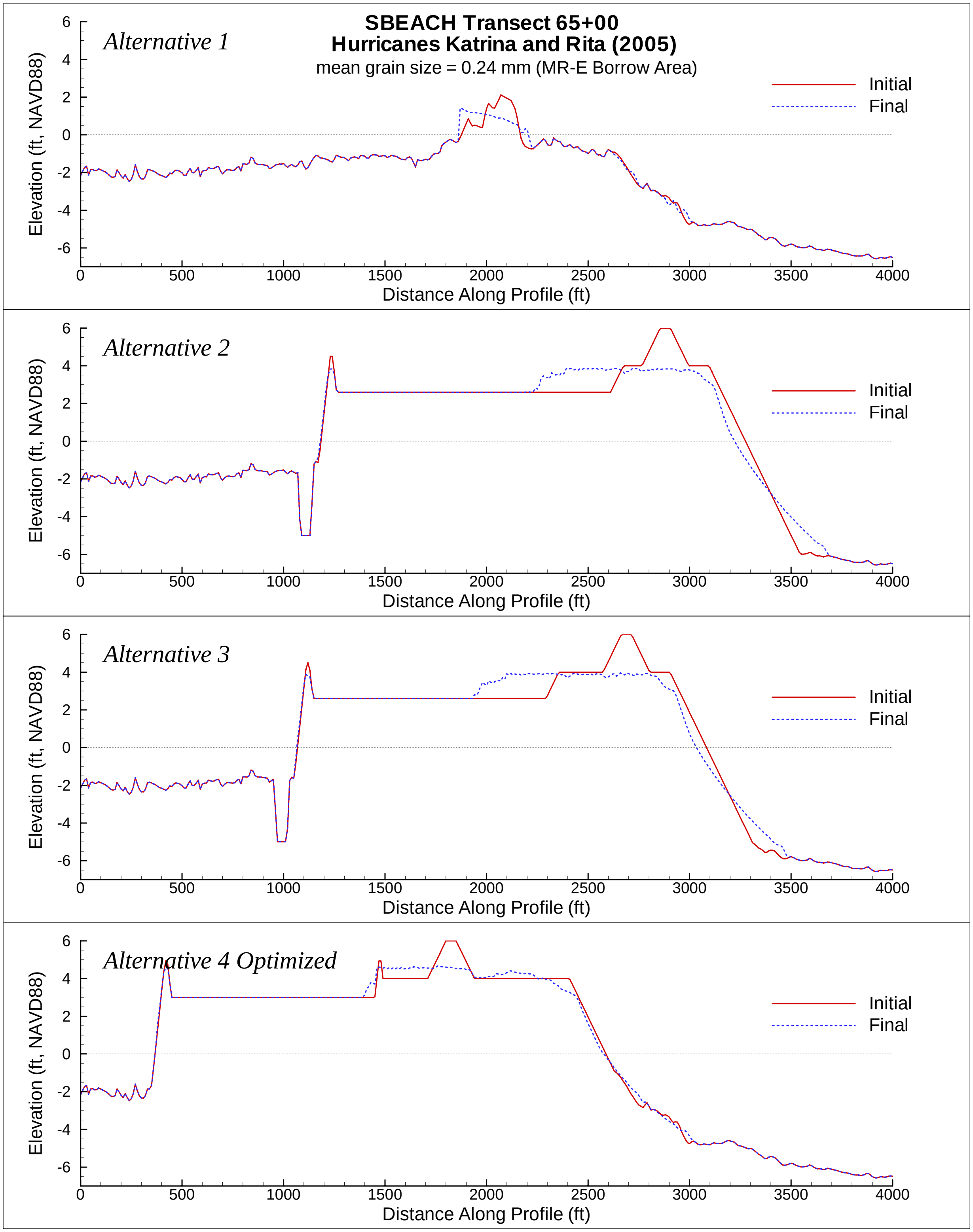



**Figure 6-11: Comparison Between Initial Beach Profile and Final Computed Post-Katrina-Rita, Beach Profiles for Alternatives 1 through 4 Along Transect 65+00 Using Mean Grain Size of 0.24 mm.**

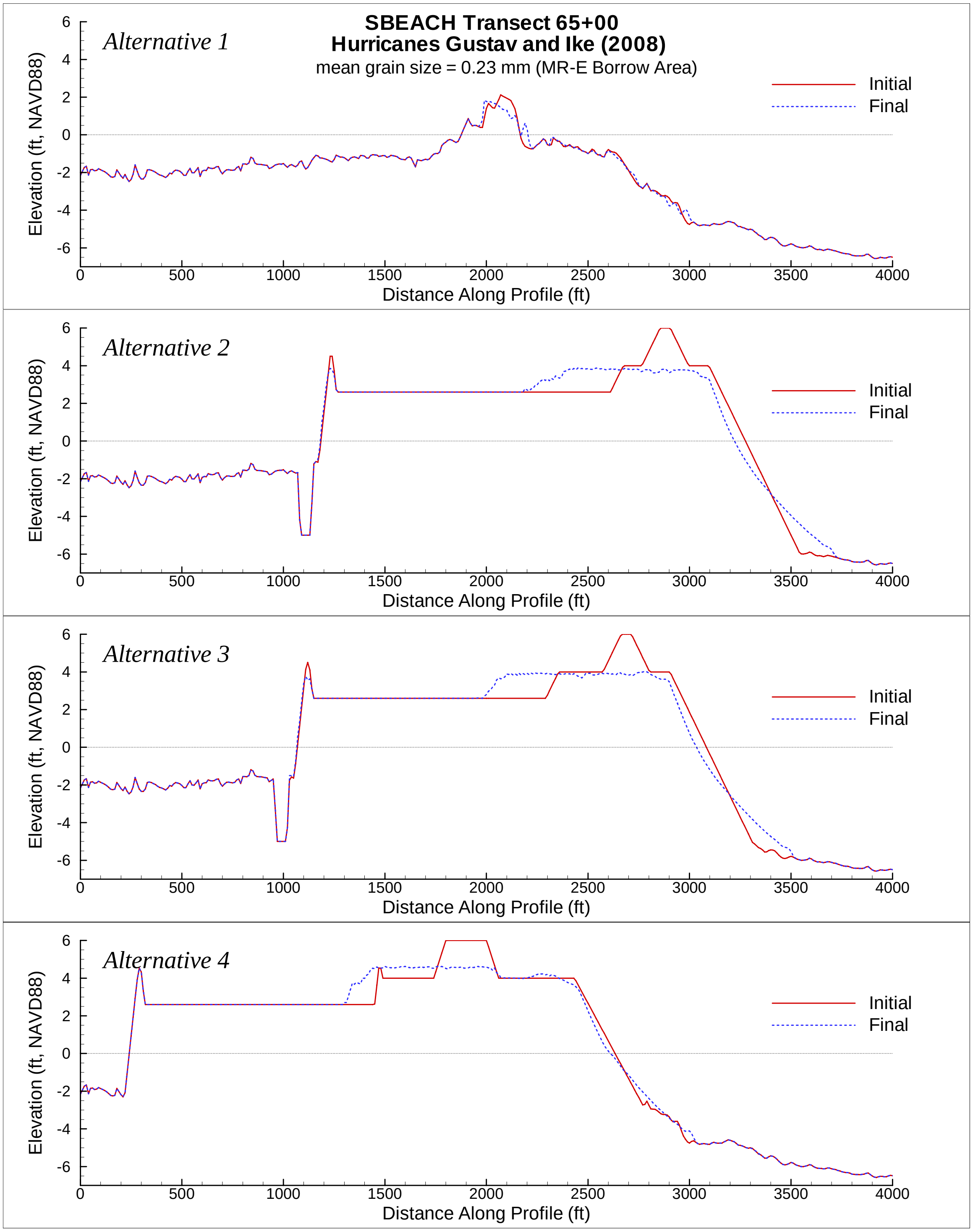



**Figure 6-12: Comparison Between Initial Beach Profile and Final Computed Post-Gustav-Ike, Beach Profiles for Alternatives 1 through 4 Along Transect 65+00 Using Mean Grain Size of 0.24 mm.**

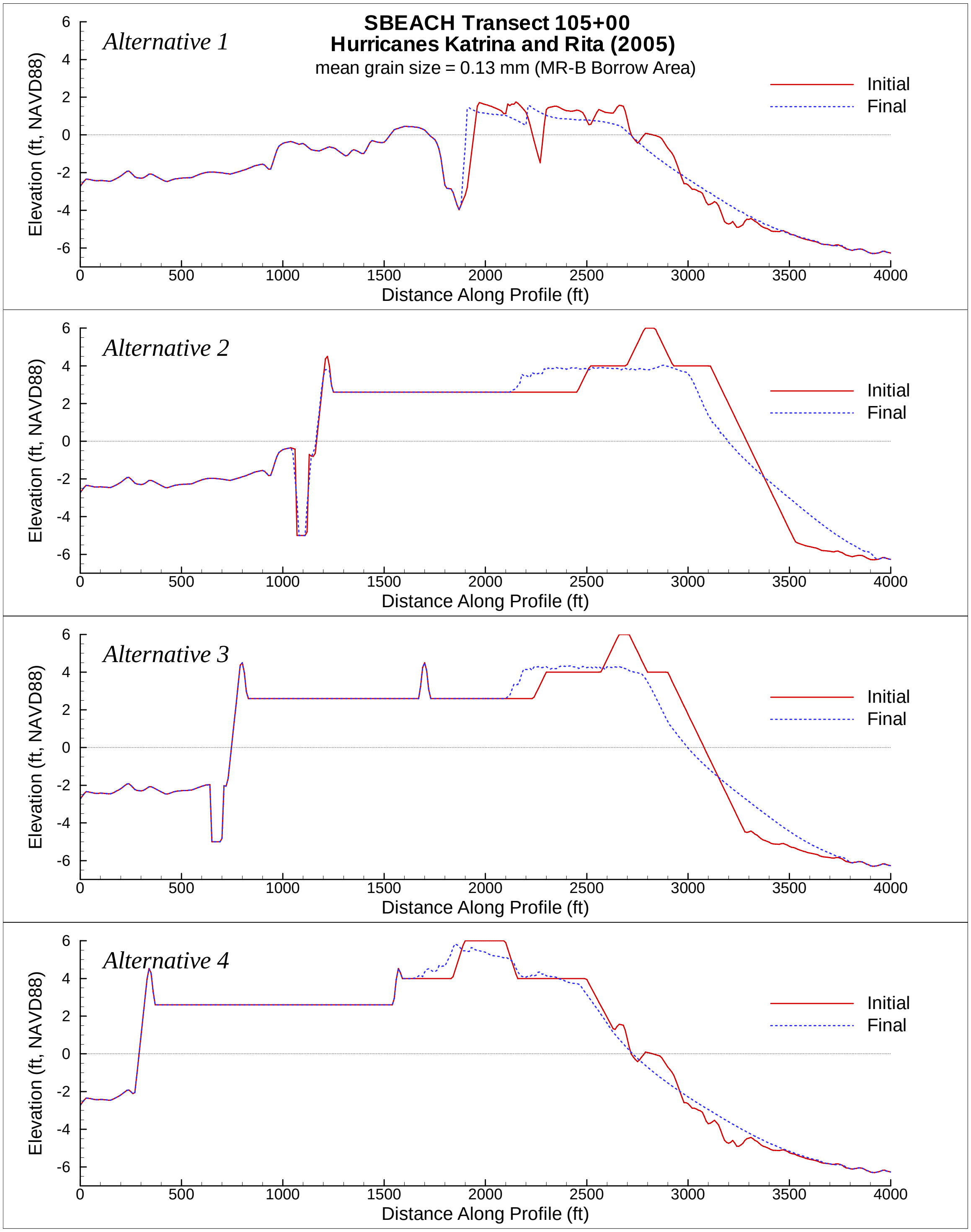



**Figure 6-13: Comparison Between Initial Beach Profile and Final Computed Post-Katrina-Rita, Beach Profiles for Alternatives 1 through 4 Along Transect 105+00 Using Mean Grain Size of 0.13 mm.**

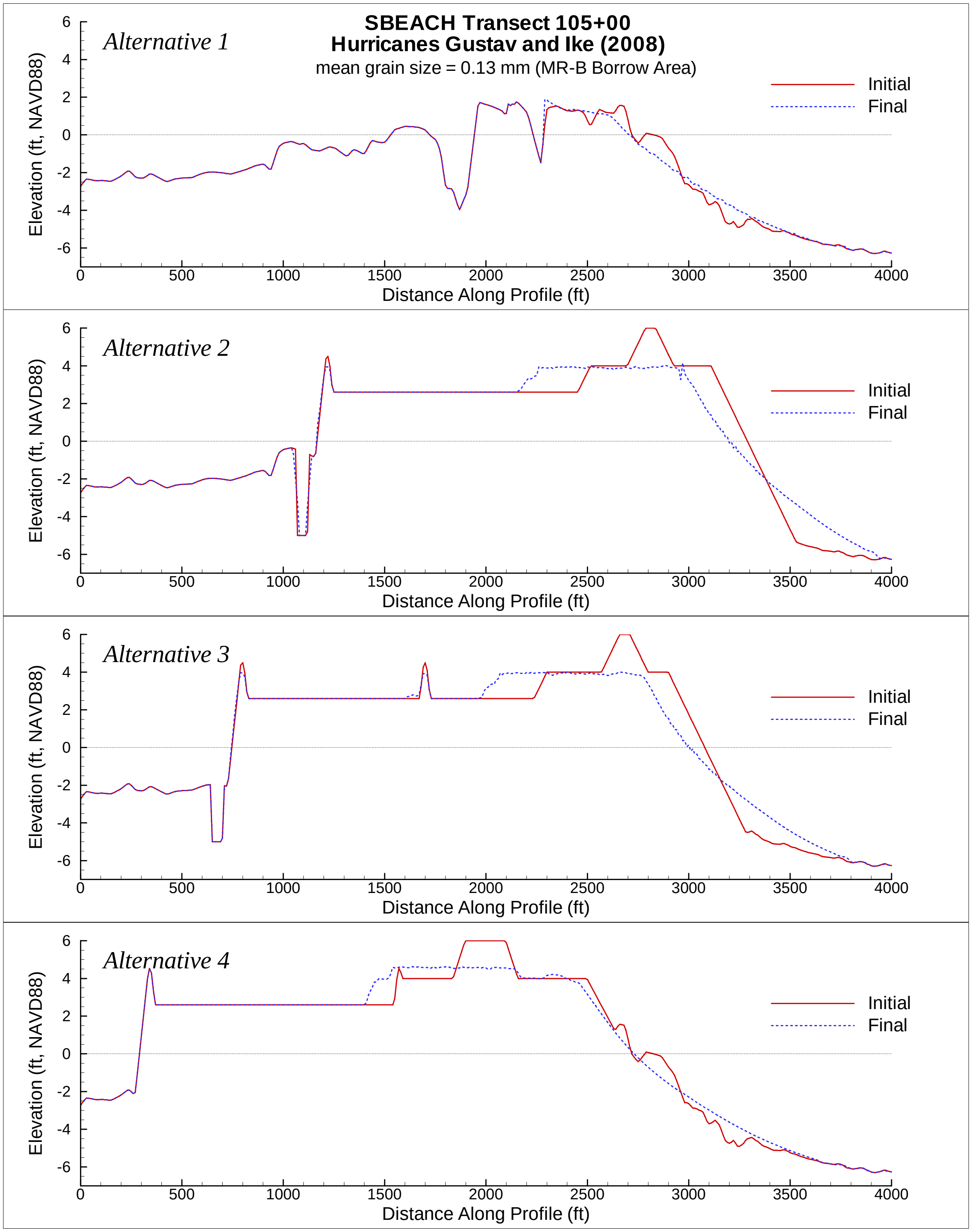



**Figure 6-14: Comparison Between Initial Beach Profile and Final Computed Post-Gustav-Ike, Beach Profiles for Alternatives 1 through 4 Along Transect 105+00 Using Mean Grain Size of 0.13 mm.**

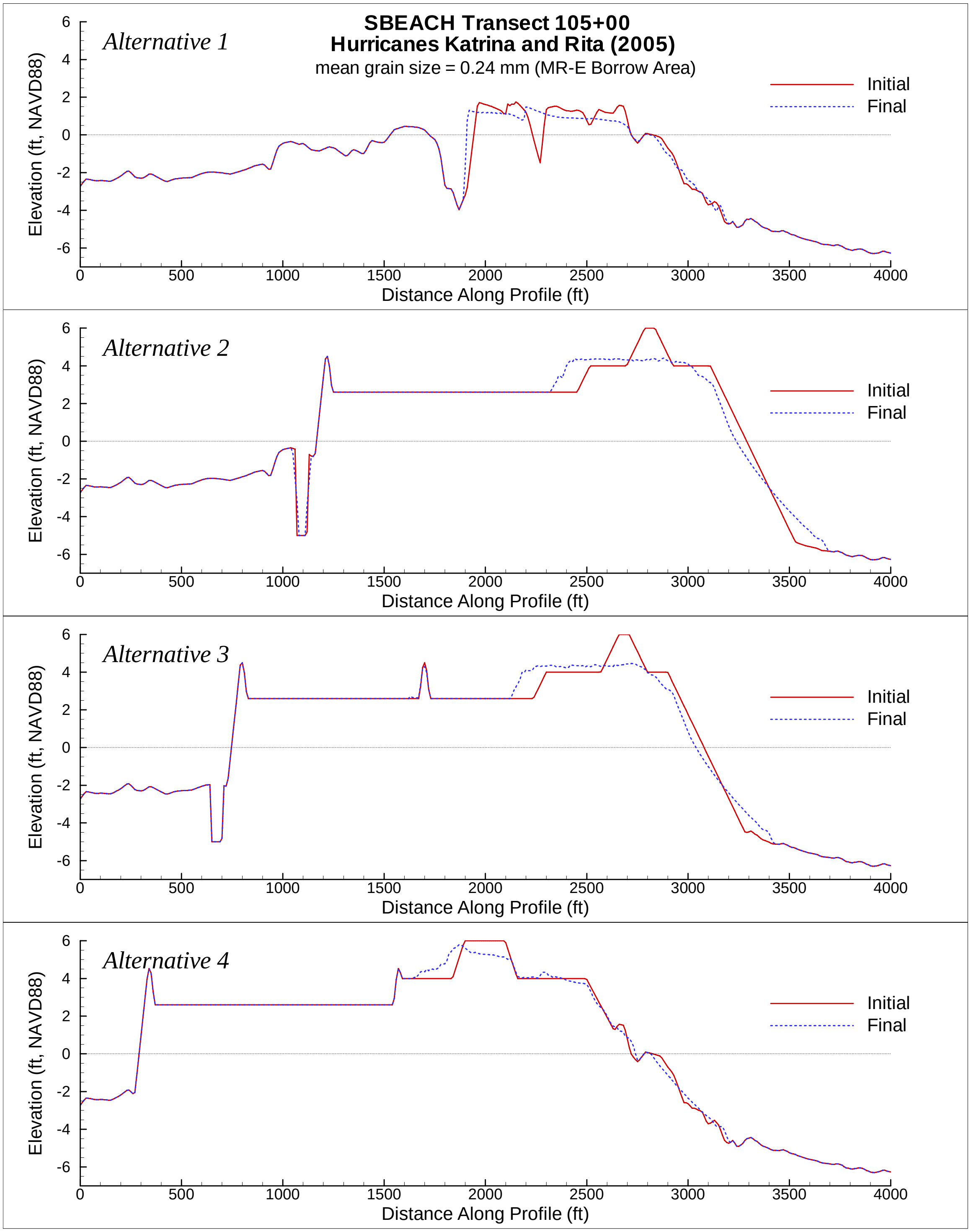



**Figure 6-15: Comparison Between Initial Beach Profile and Final Computed Post-Katrina-Rita, Beach Profiles for Alternatives 1 through 4 Along Transect 105+00 Using Mean Grain Size of 0.24 mm.**

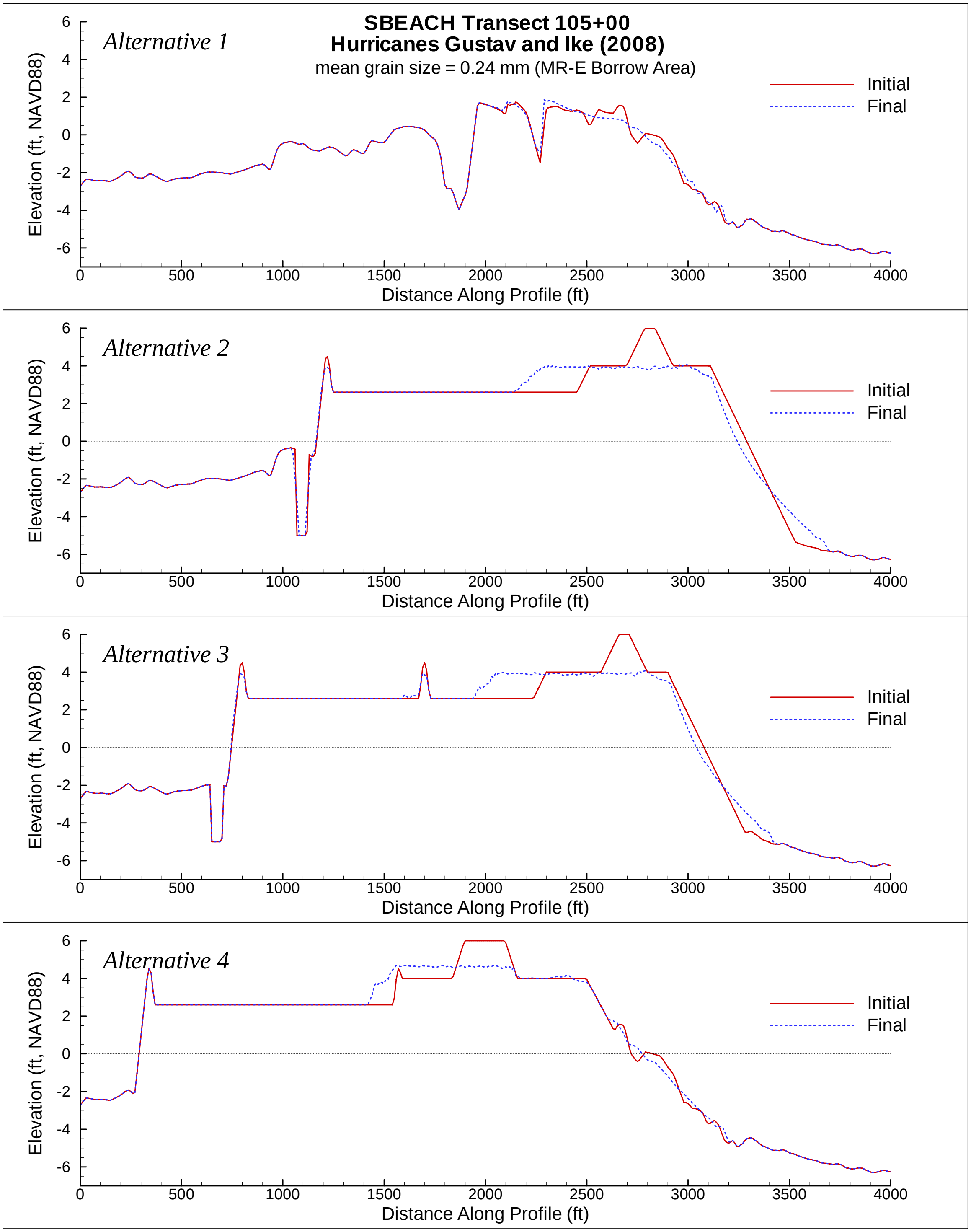



**Figure 6-16: Comparison Between Initial Beach Profile and Final Computed Post-Gustav-Ike, Beach Profiles for Alternatives 1 through 4 Along Transect 105+00 Using Mean Grain Size of 0.24 mm.**

Tables 6-1 and 6-2 present summaries of alternatives performance based on beach recession at MHW and maximum post-storm beach elevation for 0.13 mm and 0.24 mm grain size, respectively.

**Table 6-1: Alternatives Summary of Post-Storm Beach Recession Based on Grain Size of 0.13 mm.**

| Transect | Beach Recession at MHW=1.60 feet NAVD88 (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Katrina-Rita (2005) | | | | Gustav-Ike (2008) | | | |
| | Alt. 1 | Alt.2 | Alt. 3 | Alt. 4 | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 4 |
| 45+00 | N/A* | 110.6 | 119.4 | 70.7 | N/A | 103.4 | 127.2 | 73.6 |
| 65+00 | N/A | 131.1 | 125.4 | 89.2 | N/A | 127.0 | 120.6 | 85.6 |
| 105+00 | N/A | 126.4 | 118.3 | 15.5 | 328.9 | 123.9 | 117.6 | 12.5 |
| **Average** | **N/A** | **122.7** | **121.0** | **58.5** | **328.9** | **118.1** | **121.8** | **57.2** |

*N/A denotes the post-storm profile is below MHW, beach recession computation could not be performed.

**Table 6-2: Alternatives Summary of Post-Storm Beach Recession Based on Grain Size of 0.24 mm.**

| Transect | Beach Recession at MHW=1.60 feet NAVD88 (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Katrina-Rita (2005) | | | | Gustav-Ike (2008) | | | |
| | Alt. 1 | Alt.2 | Alt. 3 | Alt. 4 | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 4 |
| 45+00 | N/A* | 49.5 | 47.2 | 30.4 | N/A | 51.7 | 54.2 | 33.1 |
| 65+00 | N/A | 43.8 | 41.1 | 20.7 | 130.4 | 40.8 | 38.9 | 21.2 |
| 105+00 | N/A | 44.3 | 35.5 | -3.0 | 300.5 | 39.8 | 31.7 | -35.5 |
| **Average** | **N/A** | **45.9** | **35.5** | **16.0** | **215.5** | **44.1** | **41.6** | **6.3** |

*N/A denotes the post-storm profile is below MHW, beach recession computation could not be performed.

Similarly, Tables 6-3 and 6-4 present summaries of alternatives performance maximum post-storm beach elevation for 0.13 mm and 0.24 mm grain size, respectively.

**Table 6-3: Alternatives Summary of Maximum Post-Storm Beach/Dune Elevation Based on Grain Size of 0.13 mm.**

| Transect | Maximum Beach/Dune Elevation (NAVD88 feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Katrina-Rita (2005) | | | | Gustav-Ike (2008) | | | |
| | Alt. 1 | Alt.2 | Alt. 3 | Alt. 4 | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 4 |
| 45+00 | 0.3 | 4.0 | 3.9 | 5.6 | 0.3 | 3.9 | 4.3 | 4.7 |
| 65+00 | 1.4 | 3.9 | 3.9 | 5.8 | 1.8 | 3.9 | 4.0 | 4.6 |
| 105+00 | 1.5 | 4.0 | 4.3 | 5.8 | 1.9 | 4.0 | 4.0 | 4.6 |
| **Average** | **1.1** | **4.0** | **4.0** | **5.7** | **1.2** | **3.9** | **4.1** | **4.6** |

**Table 6-4: Alternatives Summary of Maximum Post-Storm Beach Elevation Based on Grain Size of 0.24 mm.**

| Transect | Maximum Beach/Dune Elevation (NAVD88 feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Katrina-Rita (2005) | | | | Gustav-Ike (2008) | | | |
| | Alt. 1 | Alt.2 | Alt. 3 | Alt. 4 | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 4 |
| 45+00 | 0.4 | 4.2 | 3.9 | 5.8 | 0.4 | 3.9 | 3.8 | 4.7 |
| 65+00 | 1.4 | 3.8 | 3.9 | 5.6 | 1.8 | 3.9 | 3.9 | 4.6 |
| 105+00 | 1.3 | 4.4 | 4.4 | 5.8 | 1.8 | 3.9 | 4.0 | 4.6 |
| **Average** | **1.0** | **4.1** | **4.1** | **5.7** | **1.3** | **3.9** | **3.9** | **4.6** |

Based on the post-storm alternatives performance analysis, beach profiles for Alternative 1, which is to maintain the existing conditions of the island, will recess and flatten out to a degree that the entire profiles will be near or below MHW. These results reinforce the decision to exclude Alternative 1 from future analysis, that is, No Action will result in continued significant land loss and disintegration of Scofield Island.

Alternatives 2 and 3 are comparable however Alternative 3 resulted in slightly less recession at MHW and slightly higher post-storm dune elevation. The coarser grain size, 0.24 mm, resulted in less erosion compared to model results when the grain size of 0.13 mm was used.

Alternative 4 with the largest dune among all of the alternatives resulted in the smallest shoreline recession and highest post-storm dune elevation.

### 6.1.3 Summary

Based on the results of the SBEACH modeling, Alternative 4 with the wide dune will provide better protection against storms of the magnitude that have recently impacted Scofield Island (i.e., Katrina and Rita in 2005, and Gustav and Ike in 2008). Alternatives 2 and 3 with the narrow dune will provide less protection compared to Alternative 4, however, for all of these alternatives the beach/dune system should remain intact to provide the marsh with sufficient protection to prevent severe damage and breaching. From this analysis, Alternative 4 is the preferred alternative.

## 6.2 Environmental Habitat Creation and Sustainability

In order to evaluate Project performance, the acres of habitat created by each restoration alternative, and the evolution of acres sustained through the Project life, accounting for erosion, overwash, and geologic subsidence, were computed and compared to the CWPPRA conceptual restoration plan.

### 6.2.1 Creation

The CWPPRA conceptual restoration goal for Scofield Island included construction of a total of 429 acres of beach and dune area (above-tide) and marsh platform within the original Project area of 746 acres. During the development of the alternatives, the Project area boundaries were increased to account for the extension of marsh fill placement to the north as well as to encompass the areas projected to be affected by overwash during the Project life. The Project areas for Alternatives 2 through 4 equal 1034, 984, and 919 acres, respectively, noting the majority of the increases were open water areas within the bay that are expected to be affected by the overwash processes.

Utilizing the design fill templates, the habitat acres created by Alternatives 2 through 4 were computed at Target Year (TY) 1. The habitat types computed were based on the Barrier Island Community Wetland Value Assessment Model (CWPPRA Task Force, 2003) and included the following:

- Dune: Ac > +5.0 feet NAVD88
- Supratidal: +2.0 feet NAVD88 < Ac < +4.99 feet NAVD88
- Intertidal (gulf and bay): 0.0 feet NAVD88 < Ac < +1.99 feet NAVD88
- Subtidal (bay): -1.5 feet NAVD88 < Ac < 0.0 feet NAVD88.

Table 6-5 presents the habitat acres at TY1 for the different types and the total created for each alternative. To provide for an accurate comparison to the CWPPRA TY1 goal, the subtidal (bay) and intertidal (gulf) acres were then excluded to compute an adjusted total and the ratio of acres created to the goal were derived.

**Table 6-5: TY1 Habitat Acres**

| Habitat | Alternative 2 (Ac) | Alternative 3 (Ac) | Alternative 4 (Ac) |
|---|---|---|---|
| Subtidal (Bay) | 11.0 | 23.6 | 10.8 |
| Intertidal (Bay) | 32.3 | 102.7* | 21.0 |
| Supratidal | 499.4 | 436.4 | 524.0 |
| Dune | 30.0 | 29.8 | 55.5 |
| Intertidal (Gulf) | 23.4 | 23.3 | 27.2 |
| Total | 596.0 | 615.8 | 638.5 |
| Adjusted Total | 561.6 | 568.9 | 600.6 |
| Ratio | 1.31 | 1.33 | 1.40 |

* Alternative 3 template preserves approximately 40.4 acres of existing marsh which are included in the calculation

### 6.2.2 Sustainability

The CWPPRA conceptual restoration goal for Scofield Island is to yield back-barrier habitat acreage of 278 acres at TY20. Utilizing the design fill templates, annual gulf-side erosion losses and back barrier marsh platform overwash gains derived from the Sediment Budget (Section 4.8.3), and the effects of geologic subsidence (Section 4.6), the island's evolution over time was predicted through the Project life. The habitat acres yielded by Alternatives 2 through 4 were then computed at TY20.

Table 6-6 presents the habitat acres at TY20 for the different types and the total yielded for each alternative. To provide for an accurate comparison to the CWPPRA TY20 goal, the subtidal (bay) and intertidal (gulf) acres were again excluded to compute an adjusted total and the ratio of acres yielded to the goal were derived.

**Table 6-6: TY20 Habitat Acres**

| Habitat | Alternative 2 (Ac) | Alternative 3 (Ac) | Alternative 4 (Ac) |
|---|---|---|---|
| Subtidal (Bay) | 46.4 | 51.0 | 95.5 |
| Intertidal (Bay) | 407.4 | 364.3 | 310.1 |
| Supratidal | 29.8 | 39.7 | 166.0 |
| Dune | 0.0 | 0.0 | 0.0 |
| Intertidal (Gulf) | 19.5 | 19.7 | 29.6 |
| Total | 503.1 | 474.7 | 601.2 |
| Adjusted Total | 437.2 | 404.0 | 476.1 |
| Ratio | 1.57 | 1.45 | 1.71 |

Based on the derived ratios, Alternative 4 is the preferred alternative in terms of both the habitat acres created and those sustained through TY20.

## 6.3 Land Loss Over Time

A second approach to estimate habitat acre changes over time and evaluate Project performance was conducted by applying historic land loss changes from TY1 through TY20.

### 6.3.1 Data Acquisition and Processing

The data for the Project area used to assess both the current habitat conditions and the rates of short- and long-term habitat change were either acquired as completed habitat datasets or were created using methods outlined in Penland *et al.* (2004). The existing datasets that were selected for inclusion in these assessments were:

- 1956 Habitat data - U.S. Geological Survey (1980),
    - Classified using the Cowardin, et al. system;
- 1988 Habitat data - U.S. Geological Survey (1988),
    - Classified using the Wetland Analytical Mapping System; and
- 2005 Habitat data - Louisiana Department of Natural Resources (2008),
    - Classified using the Penland, et al. system.

The habitat analyses that were performed were done so using the 2000 and 2007 color infrared aerial photography acquired from the USGS (2000) and the USDA (2007) respectively. Additionally, the 2005 Digital Orthophoto Quarter Quadrangles (DOQQ) (USGS, 2006) were acquired and used to assess the quality of the 2005 habitat classification, and as the control in the geo-rectification of the 2000 photos. The non-rectified 2000 photo frames were geo-referenced using Erdas Imagine software (version 9.3) and the 2005 DOQQs as a control. The 2000, 2005, and 2007 photography were then each mosaicked and subset using the habitat Project area boundary.

The habitat Project area consisted of the Project area boundary that was modified to encompass the erosional and migratory processes of select island features. The projection of imagery (existing habitat datasets and subset imagery) were assessed and re-projected to North American Datum 1983 (NAD83) State Plane Louisiana South FIPS 1702 as needed. Figures 6-17 through 6-21 depict the habitat acreages for 1956, 1988, 2000, 2005 and 2007 respectively within the habitat Project area boundary.

Habitat analyses were performed on the 2000 and 2007 subset imagery using an unsupervised classification with a 50-class assignment, 0.950 convergence threshold, and a maximum of 20 iterations. The accuracy of the intermediate cluster images was assessed by using the original photography, and manually recoding to improve the accuracy of classification. The original 50 classes were collapsed into seven final classes (modified from Penland, et al. 2004): Water, Marsh, Barrier Vegetation, Beach, Bare Land, Structure, and Rip-Rap. After the initial classification was complete, an accuracy assessment was performed to ensure correct classification.

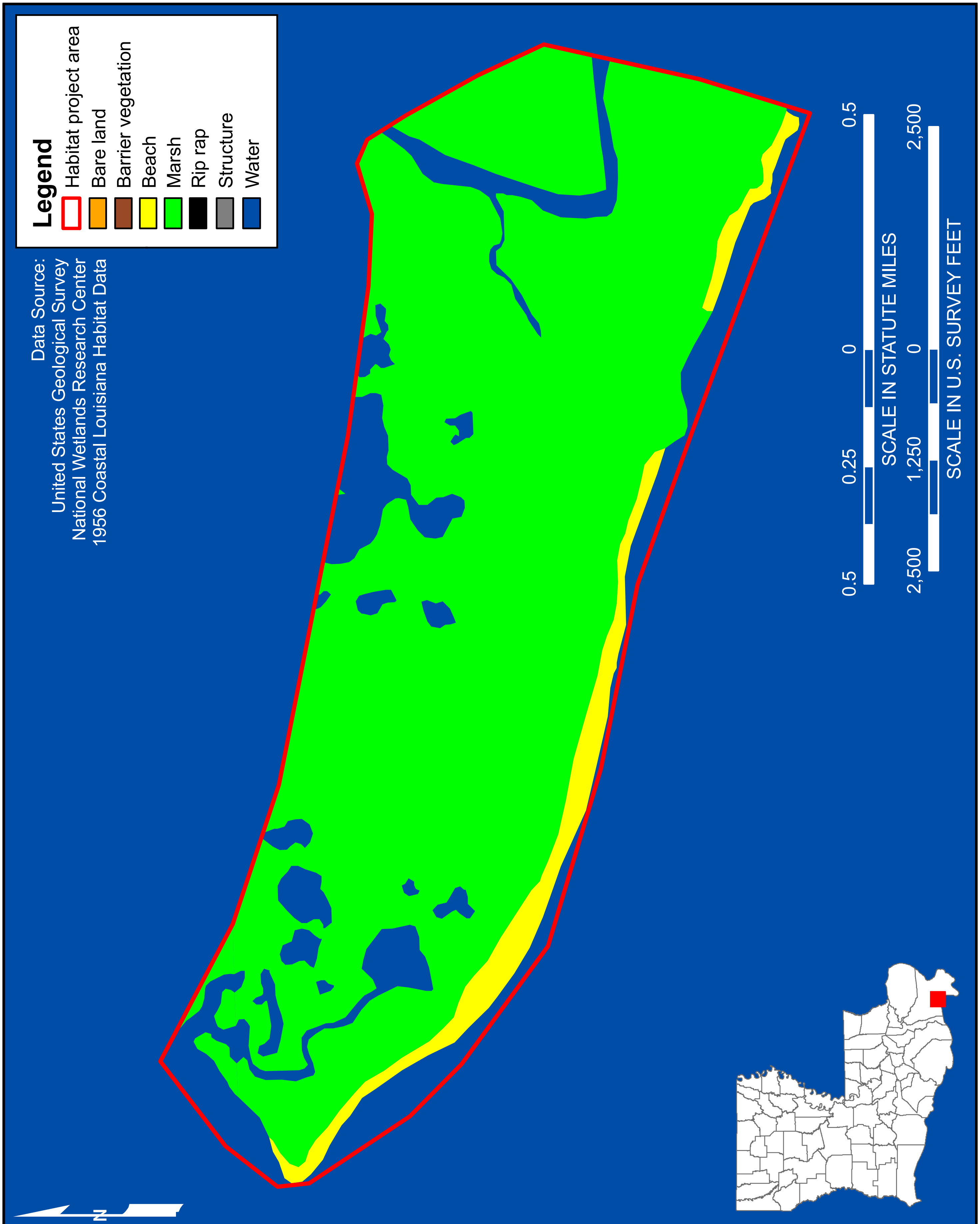



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**FIGURE 6-17**
**RIVERINE SAND MINING / SCOFIELD ISLAND RESTORATION HABITAT ANALYSIS - 1956**

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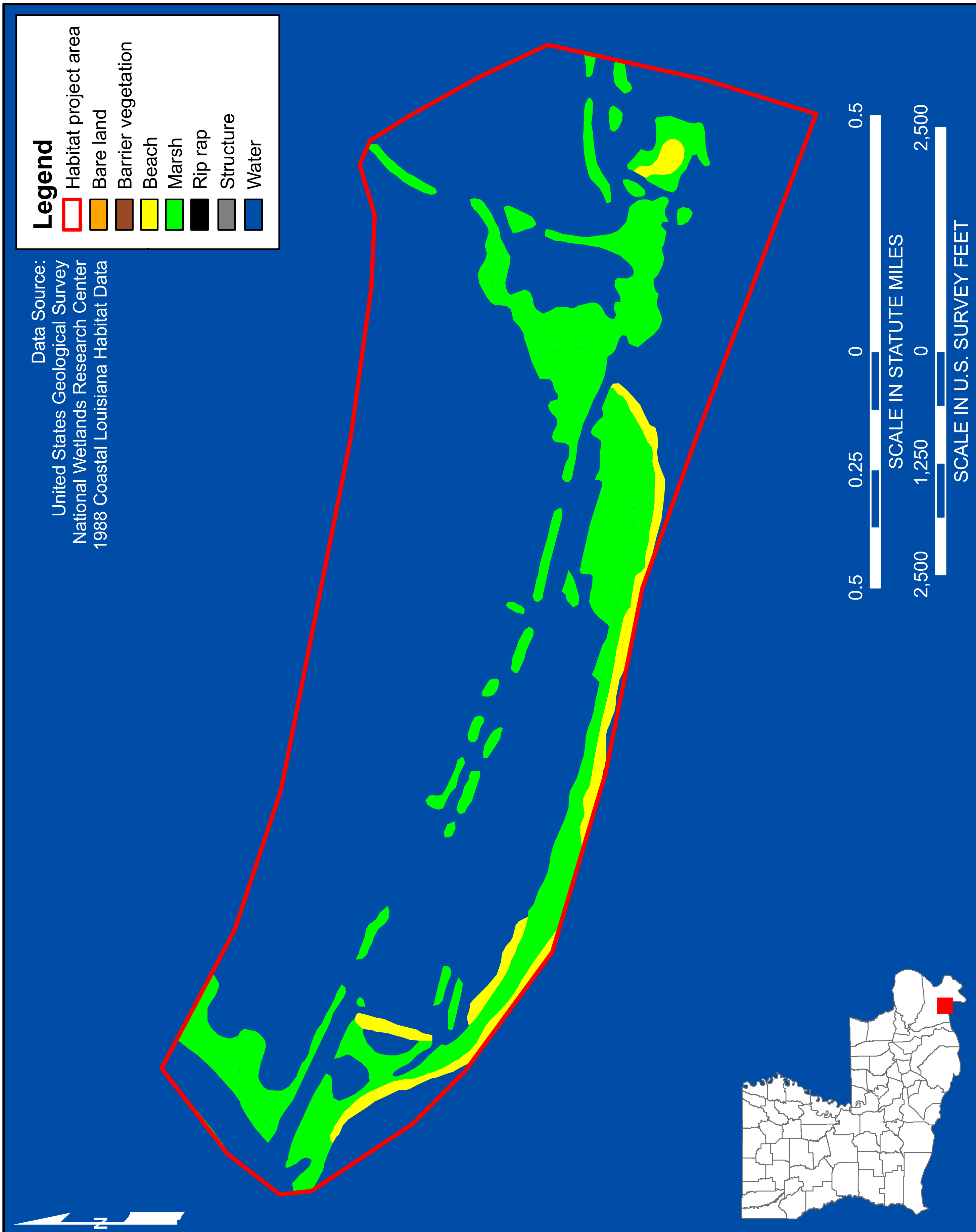


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**FIGURE 6-18**
**RIVERINE SAND MINING / SCOFIELD ISLAND RESTORATION HABITAT ANALYSIS - 1988**

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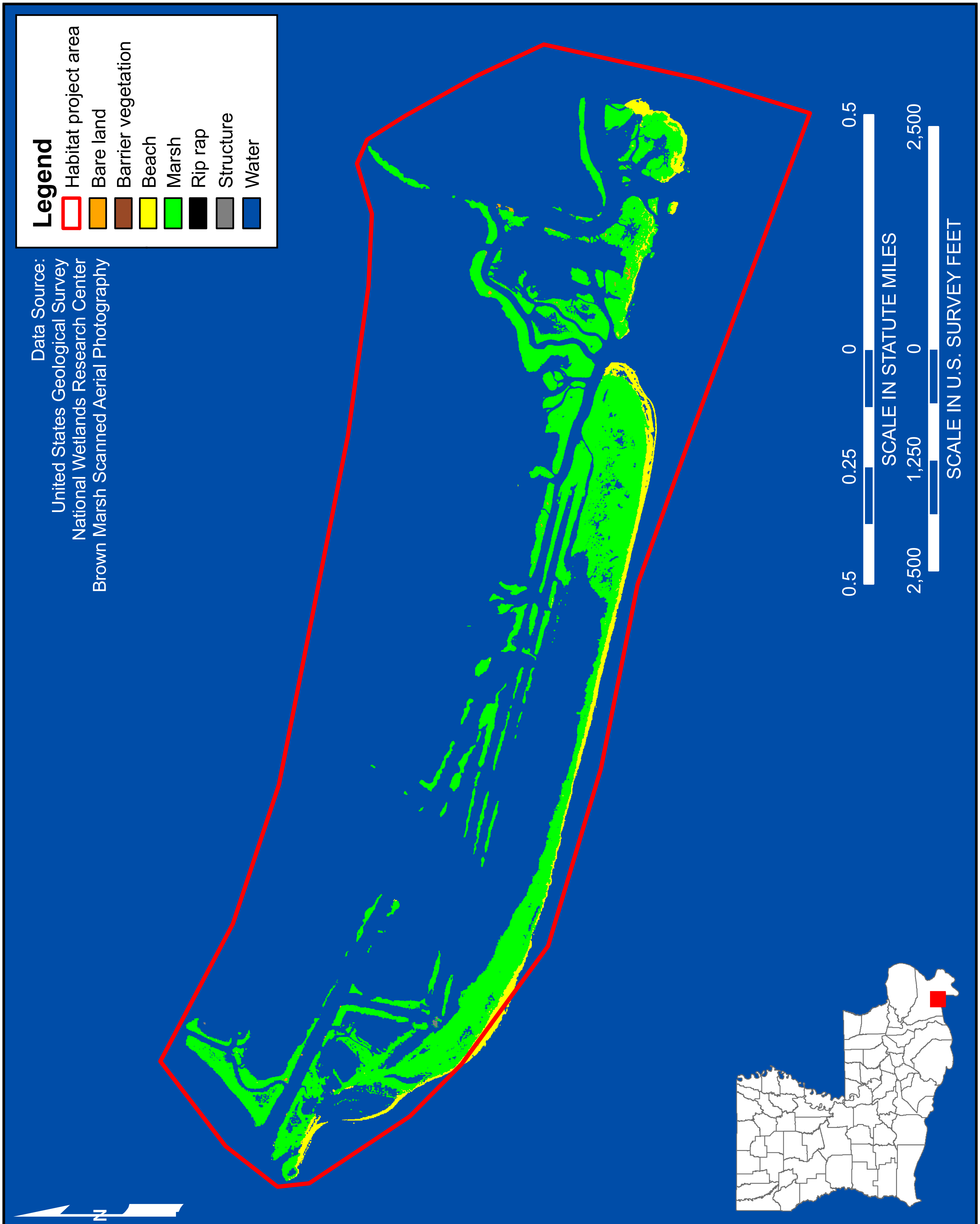



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**FIGURE 6-19**
**RIVERINE SAND MINING / SCOFIELD ISLAND RESTORATION HABITAT ANALYSIS - 2000**


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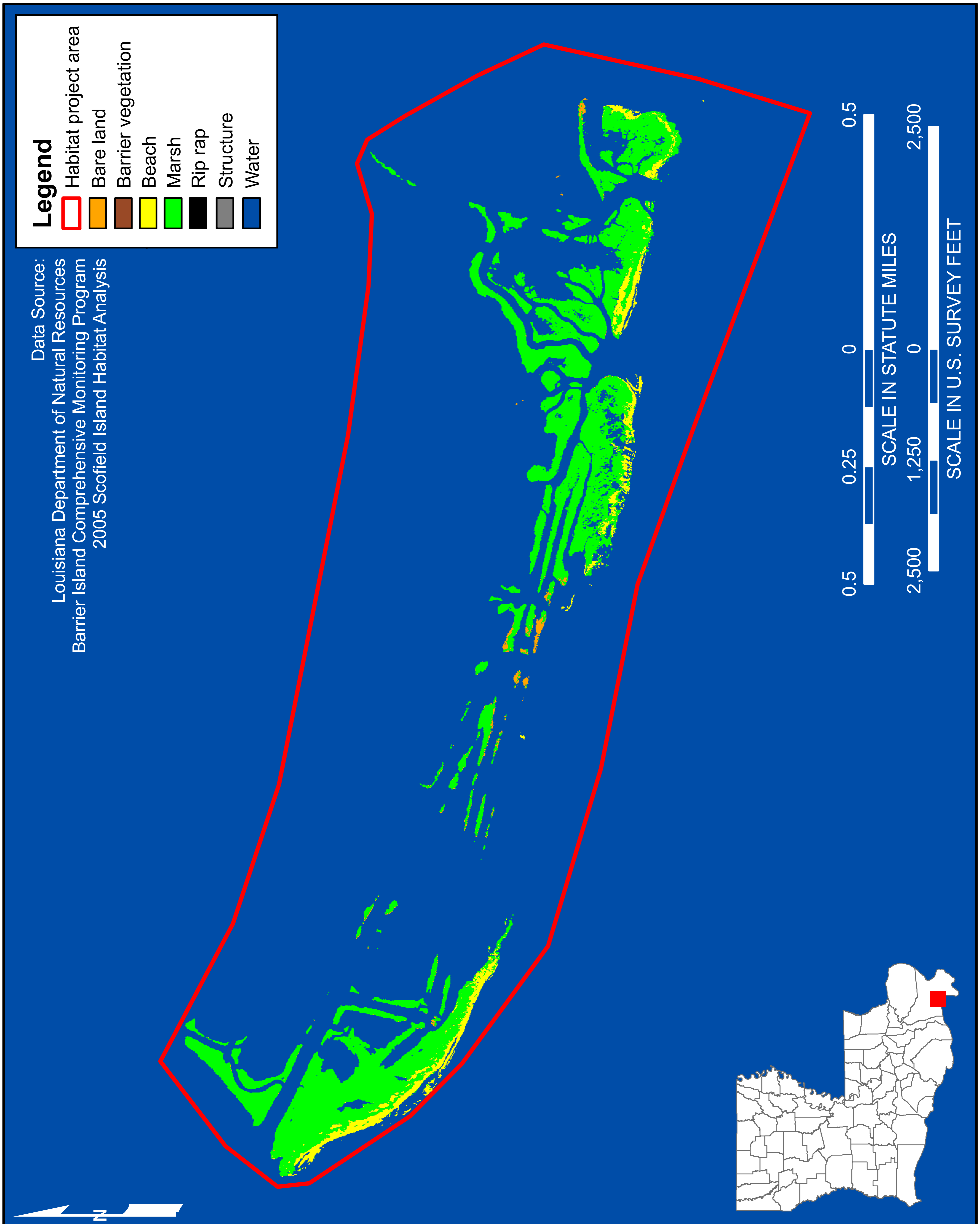


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**FIGURE 6-20**
**RIVERINE SAND MINING / SCOFIELD ISLAND RESTORATION HABITAT ANALYSIS - 2005**

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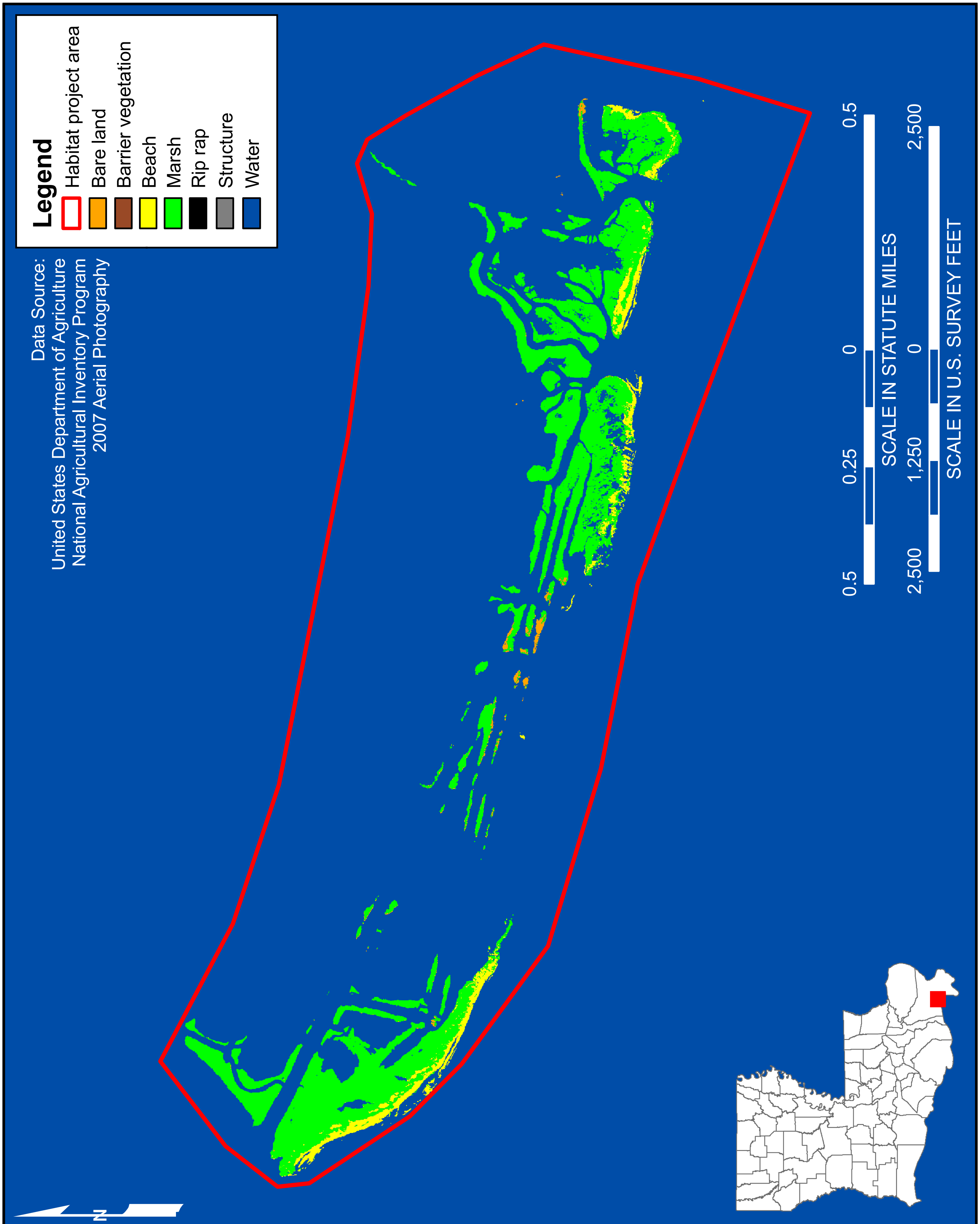


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**FIGURE 6-21**
**RIVERINE SAND MINING / SCOFIELD ISLAND RESTORATION HABITAT ANALYSIS - 2007**

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### 6.3.2 Land Loss Rates of Change

The habitat inventory was used to assess the historical, current, and future conditions. The 1956 data were used to establish baseline historical information, the 2007 data were used as a proxy for current conditions, and all dates were used to calculate the historical-, long-, short-, and near-term land change rates (Table 6-7). These rates were then evaluated, and the most applicable time series was selected for use in forecasting pre-construction degradation and future without Project predictions. The short-term (2000-2007) rates of change,–0.5, –3.3, and –3.7 ac/yr for beach, marsh, and total land respectively, were selected as the best fit rates due to the differences in classification methodology between the start and end-point datasets within the historical- and long-term series, and because of the direct hurricane impacts to the 2005 habitat. Figure 6-22 presents the short-term habitat changes between 2000 and 2007 within the habitat Project area boundary.

**Table 6-7: Annual Rates of Change Per Dominant Habitat Type**

| Period of Record | Annual Rate of Change (Acres per year) | | |
|---|---|---|---|
| | Beach | Marsh | Subtidal |
| Historical (1956-2007) | -0.73 | -13.82 | 14.54 |
| Long (1988-2007) | -0.84 | -2.92 | 3.75 |
| Short (2000-2007) | -0.45 | -3.25 | 3.70 |
| Near (2005-2007) | -0.31 | 0.09 | 0.22 |

Table 6-8 shows that in 1956 the 1,055-acre Scofield Island habitat area consisted primarily of marsh (828.2 acres), subtidal (176.5 acres), and beach (50.8 acres). Since 1956, Scofield Island has experienced significant marsh degradation and beachside erosion. From 1956 to 1988 the island experienced an approximate 76% reduction in land, decreasing from 879.0 acres to 208.6 acres. Between 1988 and 2005, Hurricanes Andrew, Katrina, and Rita significantly impacted the island, contributing to an additional 33%, or 69.7 acres of land loss.

**Table 6-8: Acres of Historic, Current, and Projected Habitat on Scofield Island**

| Years | Beach | Marsh | Total Land* | Water | Total** |
|---|---|---|---|---|---|
| 1956 | 50.8 | 828.2 | 879.0 | 176.5 | 1055.5 |
| 1988 | 29.6 | 179.0 | 208.6 | 846.9 | 1055.5 |
| 2000 | 16.9 | 146.3 | 163.2 | 892.3 | 1055.5 |
| 2005 | 16.0 | 122.9 | 138.9 | 916.6 | 1055.5 |
| 2007 | 13.8 | 123.5 | 137.3 | 918.2 | 1055.5 |
| TY1-2010† | 12.4 | 113.8 | 126.2 | 929.3 | 1055.5 |
| TY20-2030† | 3.4 | 48.8 | 52.2 | 1003.3 | 1055.5 |

* Total Land is equal to the sum of the beach and marsh acreages

** Total acreage of the habitat Project area (Project area boundary modified to encompass erosional and migratory processes of selected island features).

† Projected using the short-term (2000-2007) rates of change.

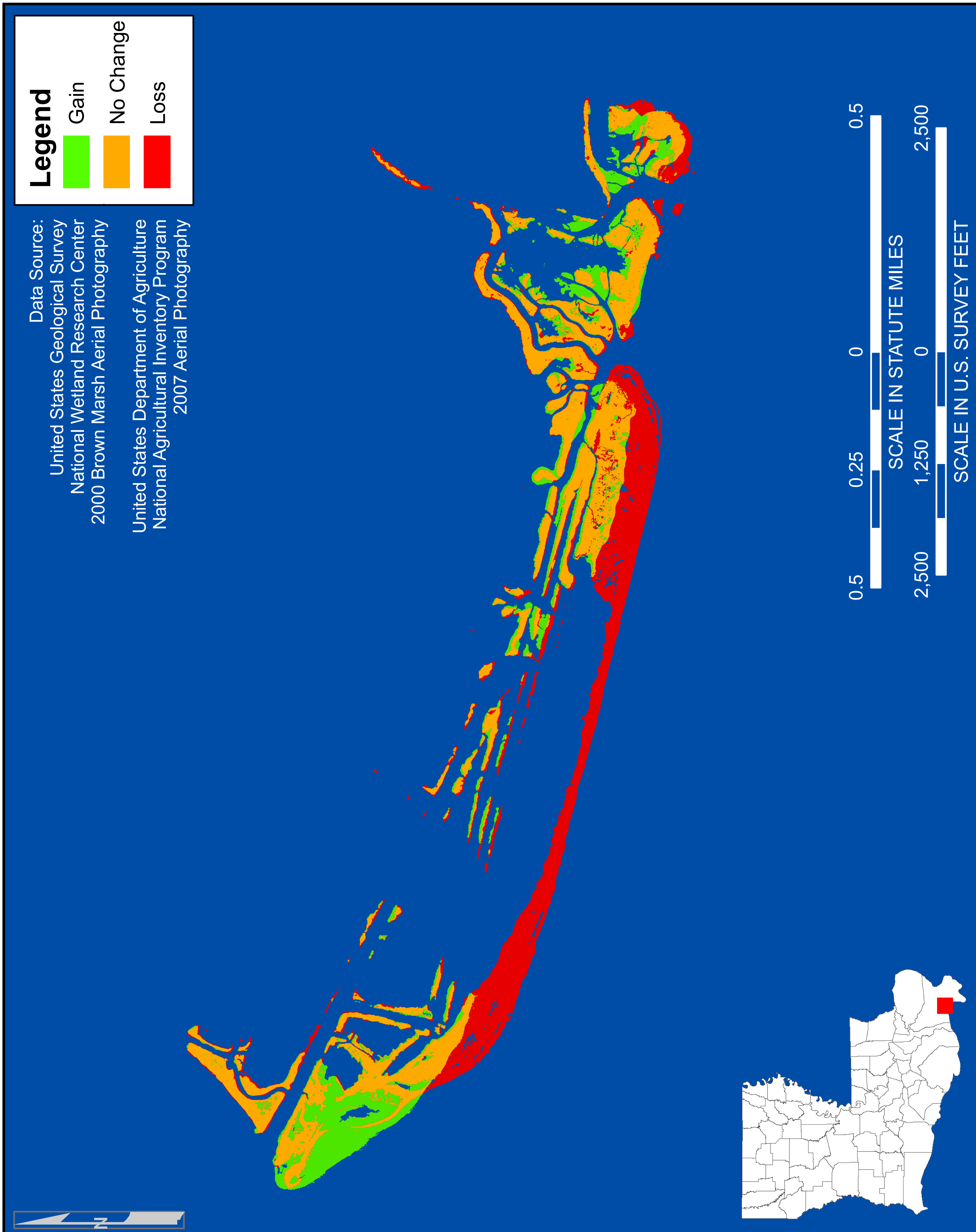


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**FIGURE 6-22**
**RIVERINE SAND MINING / SCOFIELD ISLAND RESTORATION HABITAT CHANGE - 2000-2007**

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In the near-term, the island experienced minimal land loss, changing from 138.9 acres in 2005 to 137.3 acres in 2007. The reduction in land loss during this period may be skewed due to the immediate and direct physical impacts (erosion and scouring) that Hurricanes Katrina and Rita had on the back barrier marsh of the island. Using the 2007 data as a proxy, the current land versus water acreages were calculated at 137.3 and 918.2 acres respectively, where the land component is comprised of 123.5 acres of marsh, and 13.8 acres of beach.

### 6.3.3 Future Conditions

#### 6.3.3.1 Alternative 1

The habitat Project area has experienced a loss rate of over 3.70 acres per year since the year 2000. By applying this rate of change, and assuming that the short-term rage of change will be linear over the next 20-years, the predicted habitat acreages at TY20 are 3.4 acres of beach, 48.8 acres of marsh, and 1,003.3 acres of water, and the island has a short–term year of disappearance of approximately 2044.

#### 6.3.3.2 Alternative 2

The short-term change rates were used to degrade and forecast each of the habitat types acreages, within each template/zone (based on the proportion of zonal habitat acreage to the habitat study area total), out to TY0 (2010) (Table 6-9). The projected areas of beach, marsh, and subtidal within the beach template are 3.9, 11.7, and 207.1 acres respectively. Additionally, the projected areas of dominant habitat types within the marsh template were 1.6, 77.3, and 295.8 acres for the beach, marsh, and subtidal respectively. Finally, the areas that are not directly impacted by the Alternative 2 fill templates, but do fall within the habitat Project area were projected to be 6.9, 24.7 and 426.4 acres of beach, marsh, and subtidal respectively. The TY1 (2011) projections are based on the area of fill above 0 NAVD88 for the beach template, 100-percent of the marsh fill templates, and the short-term change rates for non-impacted areas. The TY1 estimates were 164.7 and 58.1 acres of beach and subtidal respectively for the beach template, 374.8 acres of marsh within the marsh template, and 6.6, 24.0, and 427.3 acres of beach, marsh, and water respectively within the non-impacted zone. The TY20 habitat acreages were projected at 156.4 and 66.3 acres of beach and water respectively within the beach template, and 316.8 and 58.0 acres of marsh and water respectively in the marsh template. The non-impacted zone TY20 projections consist of 6.3, 20.3, and 431.4 acres of beach, marsh, and water respectively.

**Table 6-9: Acres of Historic, Current, and Projected Impacted Habitat for Alternative 2**

| Year | Alternative 2 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beach Template | | | | Marsh Template | | | | Non-Impacted Zone* | | | |
| | Beach | Marsh | Water | Total | Beach | Marsh | Water | Total | Beach | Marsh | Water | Total |
| 1956 | 35.3 | 117.9 | 69.7 | 222.8 | 2.9 | 343.5 | 28.4 | 374.8 | 12.6 | 366.8 | 78.5 | 458.0 |
| 1988 | 17.4 | 67.2 | 138.2 | 222.8 | 3.7 | 77.5 | 293.5 | 374.8 | 8.5 | 34.3 | 415.2 | 458.0 |
| 2000 | 12.5 | 53.9 | 156.4 | 222.8 | 1.7 | 74.0 | 299.0 | 374.8 | 2.8 | 18.3 | 436.8 | 458.0 |
| 2005 | 7.1 | 17.3 | 198.4 | 222.8 | 3.2 | 78.5 | 293.1 | 374.8 | 5.7 | 27.1 | 425.2 | 458.0 |
| 2007 | 4.3 | 12.7 | 205.7 | 222.8 | 1.8 | 84.0 | 289.0 | 374.8 | 7.6 | 26.8 | 423.5 | 458.0 |
| 2010 | 3.9 | 11.7 | 207.1 | 222.8 | 1.6 | 77.3 | 295.8 | 374.8 | 6.9 | 24.7 | 426.4 | 458.0 |
| 2011 | 164.7 | 0.0 | 58.1 | 222.8 | 0.0 | 374.8 | 0.0 | 374.8 | 6.6 | 24.0 | 427.3 | 458.0 |
| 2030 | 156.4 | 0.0 | 66.3 | 222.8 | 0.0 | 316.8 | 58.0 | 374.8 | 6.3 | 20.3 | 431.4 | 458.0 |

* Non-Impacted Zone is the area that is located within the habitat Project boundary but falls outside of the fill templates.

† Rows highlighted yellow are those that have been projected using the short-term change rates, or by the fill template methods.

### 6.3.3.3 Alternative 3

Similar to Alternative 2, the Alternative 3 acreages for each habitat type were projected out to TY0 using the established short-term change rates (Table 6-10). The areas of beach, marsh, and subtidal within the beach template were projected to be 5.3, 24.5, and 191.3 acres respectively. Within the marsh template, the beach, marsh, and water acreages were projected to be 0.4, 35.5, and 283.4 respectively by TY0. Those areas that are not directly impacted by the alternative 3 fill templates were estimated to be 7.0, 53.9, and 454.6 acres of beach, marsh, and water respectively. The TY1 projections for Alternative 3 were based on the same criteria that were specified in the Alternative 2 description. The TY1 estimates were 170.0 acres of beach and 50.7 acres of subtidal within the beach template, 319.4 acres of marsh within the marsh template, and 6. 7, 52.3, and 456.4 acres of beach, marsh, and water respectively, within the non-impacted area. The TY20 habitat acreages were projected at 161.8 and 59.0 acres of beach and water respectively within the beach template, and 266.3 and 53.1 acres of marsh and water respectively in the marsh template. The TY20 non-impacted zone habitats were projections at 6.4, 43.6, and 465.4 acres of beach, marsh, and water respectively.

**Table 6-10: Acres of Historic, Current, and Projected Impacted Habitat for Alternative 3**

| Year | Alternative 3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beach Template | | | | Marsh Template | | | | Non-Impacted Zone* | | | |
| | Beach | Marsh | Water | Total | Beach | Marsh | Water | Total | Beach | Marsh | Water | Total |
| 1956 | 34.3 | 163.9 | 22.6 | 220.7 | 0.0 | 290.3 | 29.1 | 319.4 | 16.5 | 374.0 | 124.9 | 515.4 |
| 1988 | 22.9 | 79.8 | 118.1 | 220.7 | 0.5 | 32.0 | 286.9 | 319.4 | 6.3 | 67.2 | 442.0 | 515.4 |
| 2000 | 12.0 | 68.3 | 140.4 | 220.7 | 0.4 | 33.8 | 285.2 | 319.4 | 4.5 | 44.2 | 466.7 | 515.4 |
| 2005 | 9.6 | 30.4 | 180.8 | 220.7 | 0.6 | 35.5 | 283.3 | 319.4 | 5.8 | 57.1 | 452.5 | 515.4 |
| 2007 | 5.6 | 26.5 | 188.7 | 220.7 | 0.5 | 38.6 | 280.3 | 319.4 | 7.7 | 58.5 | 449.2 | 515.4 |
| 2010 | 5.0 | 24.4 | 191.3 | 220.7 | 0.4 | 35.5 | 283.4 | 319.4 | 7.0 | 53.9 | 454.6 | 515.4 |
| 2011 | 170.0 | 0.0 | 50.7 | 220.7 | 0.0 | 319.4 | 0.0 | 319.4 | 6.7 | 52.3 | 456.4 | 515.4 |
| 2030 | 161.8 | 0.0 | 59.0 | 220.7 | 0.0 | 266.3 | 53.1 | 319.4 | 6.4 | 43.6 | 465.4 | 515.4 |

* Non-Impacted Zone is the area that is located within the habitat Project boundary but falls outside of the fill templates.

† Rows highlighted yellow are those that have been projected using the short-term change rates, or by the fill template methods.

### 6.3.3.4 Alternative 4

As with Alternatives 2 and 3, the acreages for each habitat were projected out to TY0 using the established short-term change rates (Table 6-11). The areas of beach, marsh, and water within the beach template were projected to be 1.4, 64.1, and 214.1 acres respectively. Within the marsh template, the beach, marsh, and water acreages were projected to be 0.0, 20.1, and 279.1 respectively by TY0. The non-impacted areas were projected to be 11.0, 29.6, and 436.1 acres of beach, marsh, and water respectively. The TY1 projections for Alternative 4 were based on the same criteria that were specified in the Alternative 2 descriptions. The TY1 estimates were 279.6 acres of beach within the beach template, 299.3 acres of marsh within the marsh template, and 10.6, 28.8, and 437.3 acres of beach, marsh, and water respectively within the non-impacted area. The TY20 habitat acreages were projected at 271.3 and 8.3 acres of beach and water respectively within the beach template, and 242.5 and 56.7 acres of marsh and water respectively in the marsh template. The TY20 non-impacted zone habitats were projections at 10.3, 23.3, and 443.1 acres of beach, marsh, and water respectively.

**Table 6-11: Acres of Historic, Current, and Projected Impacted Habitat for Alternative 4**

| Year | Alternative 4 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beach Template | | | | Marsh Template | | | | Non-Impacted Zone* | | | |
| | Beach | Marsh | Water | Total | Beach | Marsh | Water | Total | Beach | Marsh | Water | Total |
| 1956 | 0.0 | 260.7 | 18.9 | 279.6 | 0.0 | 265.0 | 34.3 | 299.3 | 50.8 | 302.5 | 123.4 | 476.7 |
| 1988 | 2.0 | 60.2 | 217.3 | 279.6 | 2.0 | 27.3 | 269.9 | 299.3 | 25.6 | 91.4 | 359.6 | 476.7 |
| 2000 | 1.3 | 62.3 | 216.0 | 279.6 | 0.1 | 18.5 | 280.7 | 299.3 | 15.5 | 65.5 | 395.7 | 476.7 |
| 2005 | 3.0 | 65.1 | 211.5 | 279.6 | 0.0 | 21.2 | 278.1 | 299.3 | 12.9 | 36.7 | 427.0 | 476.7 |
| 2007 | 1.6 | 69.5 | 208.5 | 279.6 | 0.0 | 21.9 | 277.4 | 299.3 | 12.2 | 32.2 | 432.3 | 476.7 |
| 2010 | 1.4 | 64.1 | 214.1 | 279.6 | 0.0 | 20.1 | 279.1 | 299.3 | 11.0 | 29.6 | 436.1 | 476.7 |
| 2011 | 279.6** | 0.0 | 0.0 | 279.6 | 0.0 | 299.3 | 0.0 | 299.3 | 10.6 | 28.8 | 437.3 | 476.7 |
| 2030 | 271.3 | 0.0 | 8.3 | 279.6 | 0.0 | 242.5 | 56.7 | 299.3 | 10.3 | 23.3 | 443.1 | 476.7 |

* Non-Impacted Zone is the area that is located within the habitat Project boundary but falls outside of the fill templates.

** The Alternative 4 FY01 beach acreage (calculated from 0-NAVD) is 291.2, however the total impacted area of the beach template is 279.6. The difference is existing (pre-construction) beach that is in the immediate vicinity of, but falls outside of the beach fill template

† Rows highlighted yellow are those that have been projected using the short-term change rates, or by the fill template methods.

### 6.3.4 Summary

Through application of the historic land loss rates derived from the methodologies described herein, the projected beach and marsh combined acreages at TY20 were 52.4, 499.8, 478.1, and 547.4 acres for Alternatives 1 through 4, respectively. Thus, Alternative 4 is the preferred alternative in terms of sustaining beach and marsh acres over time.

The TY20 habitat acres predicted over time using the methods outlined in Section 6.2 yielded similar results, that being, 456.7, 423.7, and 505.7 for Alternatives 2 through 4, respectively, when comparing among the three alternatives. These values were based on the area of fill above 0 feet NAVD88 and were derived by subtracting the subtidal values from the totals. The two methods provide a high degree of confidence in predicting the environmental habitat benefits over time from Project construction.

## 6.4 Fiscal Analysis

### 6.4.1 Introduction

The Preliminary Opinion of Project Cost for the three alternatives was determined by computing the costs based on equipment types and estimates of production rates, historical bids, professional experience, and consultation with construction contractors. The opinion of costs were composed of the following items: mobilization and demobilization, conveyance corridor pipeline crossings, surveying, access channels, marsh fill, containment dikes, beach and dune fill, inspection, and construction administration. Details on the borrow areas and conveyance corridor are fully described in the Main Report.

Construction duration was based on excavation equipment method, equipment capacity, weather days, and mobilization and demobilization durations. Pumping duration was based on the required volume divided by the dredging capacity per day. Weather days were based on the percentage of pumping duration per year multiplied by 56.

### 6.4.2 Mobilization and Demobilization

The mobilization and demobilization cost estimates were based on the anticipated plant and equipment in the Mississippi River for excavation and placement of beach and dune fill sediments as well as offshore for excavation and placement of the marsh fill. The derived costs were then compared to historic contract bids from the USACE and OCPR projects of a similar nature. These costs varied as factors such as pipeline length were different for each alternative.

### 6.4.3 Conveyance Corridor Sediment Pipeline Crossings

Costs for installation of a sediment pipeline from the Mississippi River bank, across the river levee, under infrastructure, and across the Hurricane Protection Levee in the vicinity of Conveyance Corridor were evaluated. The utilization of the Conveyance Corridor requires the sediment pipeline to cross the Mississippi River Levee, pass underneath Highway 11 and Louisiana Highway 23 with the installation of a 42-inch conduit pipe through the use of the jack and bore method, and cross over the Hurricane Protection Levee. Further, a submerged crossing is necessary at the Empire Harbor Canal.

### 6.4.4 Surveying

Surveying costs were comprised of a daily rate applied to the actual sediment pumping duration, weather days, and mobilization days, travel and the installation and maintenance of marsh fill grade stakes.

### 6.4.5 Access Channel

The access channel from the Gulf of Mexico through Scofield Bayou and into the back-bay at Scofield Island was priced based on a unit cost per cubic yard derived from estimates of daily equipment costs and production rates. The volume was estimated using the 2008 survey of the access channel.

### 6.4.6 Marsh Fill

The unit price per cubic yard for marsh fill in place was generated based on estimates of daily equipment costs and production rates and verified by comparing to historical OCPR bid tabulations. The volume was estimated using the 2008 survey of the island and adjusted to account for overwash processes between the date of the survey and the anticipated start date of construction and an associated cut to fill ratio.

### 6.4.7 Containment Dikes

The containment dike unit cost per linear foot was estimating utilizing daily equipment costs and production rates. The volume was estimated using the 2008 survey of the island and an applied cut to fill ratio. This unit cost was first computed for cubic yards to be placed within the dike templates and then converted to a cost per linear foot by dividing the cost of dredging the required volume by the total linear feet.

### 6.4.8 Beach and Dune Fill

The beach and dune fill costs were estimated by considering the day rate for dredge and booster pumps, fuel, per foot pipeline costs, and supporting equipment costs, as well as the estimated construction duration for each alternative based on sediment flow rate, weather days, and mobilization and demobilization days. The beach and dune fill costs were improved based on professional experience and consultation with dredging experts. The beach and dune fill unit costs vary based on factors such as differing construction duration and dividing certain fixed costs by the total quantity.

### 6.4.9 Inspection / Construction Administration

The construction inspection daily rate was based on the sediment pumping duration, weather days, and demobilization days plus a lump sum for travel. The construction administration daily rate was based on the estimated construction duration plus a lump sum for travel.

### 6.4.10 Preliminary Opinion of Construction Cost

Applying these unit prices, accurate bid quantities, and a 15% contingency, the Preliminary Opinion of Construction Cost for Alternatives 2 through 4 were derived and are presented in Table 6-12.

Alternative 3 is the least cost alternative noting it preserves existing marsh on Scofield Island, thus the fill volume is the lowest. Alternative 4 is the most expensive alternative noting the total fill volume is slightly higher than Alternative 2.

**Table 6-12: Preliminary Opinion of Construction Cost Per Alternative**

| Alternative | Preliminary Opinion of Cost |
|---|---|
| 2 | $49,415,000 |
| 3 | $47,579,000 |
| 4 | $50,582,000 |

# 7.0 GEOTECHNICAL ANALYSIS

## 7.1 Compatibility Analysis

### 7.1.1 Grain Size and Overfill Ratio

The borrow areas identified for the Scofield Island Restoration Area specific to the beach and dune include two (2) sand deposits in the Mississippi River denoted as MR-B-09 and MR-E-09 as fully described in the Preliminary Design Main Report and Mississippi River Borrow Area Design Analysis (Appendix E).

The composites of the noncohesive samples from the two borrow area cores were both determined to be fine sand. The mean grain size for MR-B-09 is 0.16 mm and for MR-E-09 is 0.19 mm and was computed by using the Method of Moments subroutine calculations within the gINT Geotechnical and Geoenvironmental software (CTC, 2008).

The analysis of borrow area sediments is applied to noncohesive sediments and uses the overfill ratio method proposed by Dean (1986). An overfill ratio ($R_A$) is a means of predicting the quantity of borrow material needed for one unit of stable beach material for use in dune and beach restoration. An overfill ratio of 1.05 means that 1.05 cubic yards of sand has to be dredged from a borrow area and placed on the beach for one (1) cubic yard of beach fill that is desired to remain in place on a nourished beach. This technique does not include losses due to the dredging process nor background erosion rates.

As a basis for comparison, native beach samples were used to develop a beach composite sample for comparison to the proposed borrow materials. Table 7-1 presents the mean grain size and overfill computations for a select group of core samples that represent the characteristics of the sediments within the limits of the refined borrow area plan. The mean grain size in MR-B-09 for the individual sample composites ranged from 0.13 to 0.21 mm and from 0.15 to 0.22 mm in MR-E-09. Borrow Area MR-B-09 average mean grain size was 0.16 mm and 0.19 mm for Borrow Area MR-E-09. The overfill ratios for the individual sample composites in MR-B-09 ranged from 1.03 to 1.11. Borrow Area MR-E-09 overfill ratios were more uniform and ranged from 1.02 to 1.04. Borrow Area MR-B-09 average overfill ratio was 1.08 and Borrow Area MR-E-09 average overfill ratio was 1.03. The grain size frequency curves for the overall borrow area composite samples are compared to the native beach in Figure 7-1. The curves have a high degree of similarity, with the borrow material being finer than the native beach material.

An additional analysis useful for the evaluation of noncohesive granular beach fill material is the renourishment factor ($R_J$). This analysis provides an estimate of how often fill placement would be required to maintain a specific beach dimension. $R_j$ (James, 1975) is a relative stability indicator. It attempts to predict long-term performance of different fill materials. Table 7-2 presents the $R_J$ factor for the select individual sample composites that were analyzed. An $R_J$ of 1.0 infers that the borrow material would perform the same as the native material. The average renourishment factors were 1.89 and 1.32 for the Borrow Areas MR-B-09 and MR-E-09, respectively. The renourishment factors suggest Borrow Area MR-E-09 will provide more suitable material for the beach and dune fill than that of Borrow Area MR-B-09.

**Table 7-1: Mean Grain Size and Overfill Computations**

| **Sediment Sample Name** | **Mean Grain Size (phi)** | **Mean Grain Size (mm)** | **Overfill Ratio** (RA) |
|---|---|---|---|
| **Borrow Area MR-B-09** | | | |
| MRB-08-05C | 2.91 | 0.13 | 1.13 |
| MRB-08-06C | 2.91 | 0.13 | 1.10 |
| MRVC-05-04C | 2.22 | 0.21 | 1.03 |
| MRVC-05-05C | 2.61 | 0.16 | 1.03 |
| MRVC-05-06C | 2.84 | 0.14 | 1.11 |
| **MR-B-09 Average** | 2.70 | 0.16 | 1.08 |
| **Borrow Area MR-E-09** | | | |
| MRE-08-05C | 2.16 | 0.22 | 1.03 |
| MRE-08-07C | 2.38 | 0.19 | 1.03 |
| MRE-08-10C | 2.65 | 0.16 | 1.03 |
| MRE-08-11C | 2.70 | 0.15 | 1.04 |
| MRVC-05-07C | 2.16 | 0.15 | 1.03 |
| MRVC-05-10C | 2.23 | 0.21 | 1.02 |
| **MR-E-09 Average** | 2.38 | 0.19 | 1.03 |

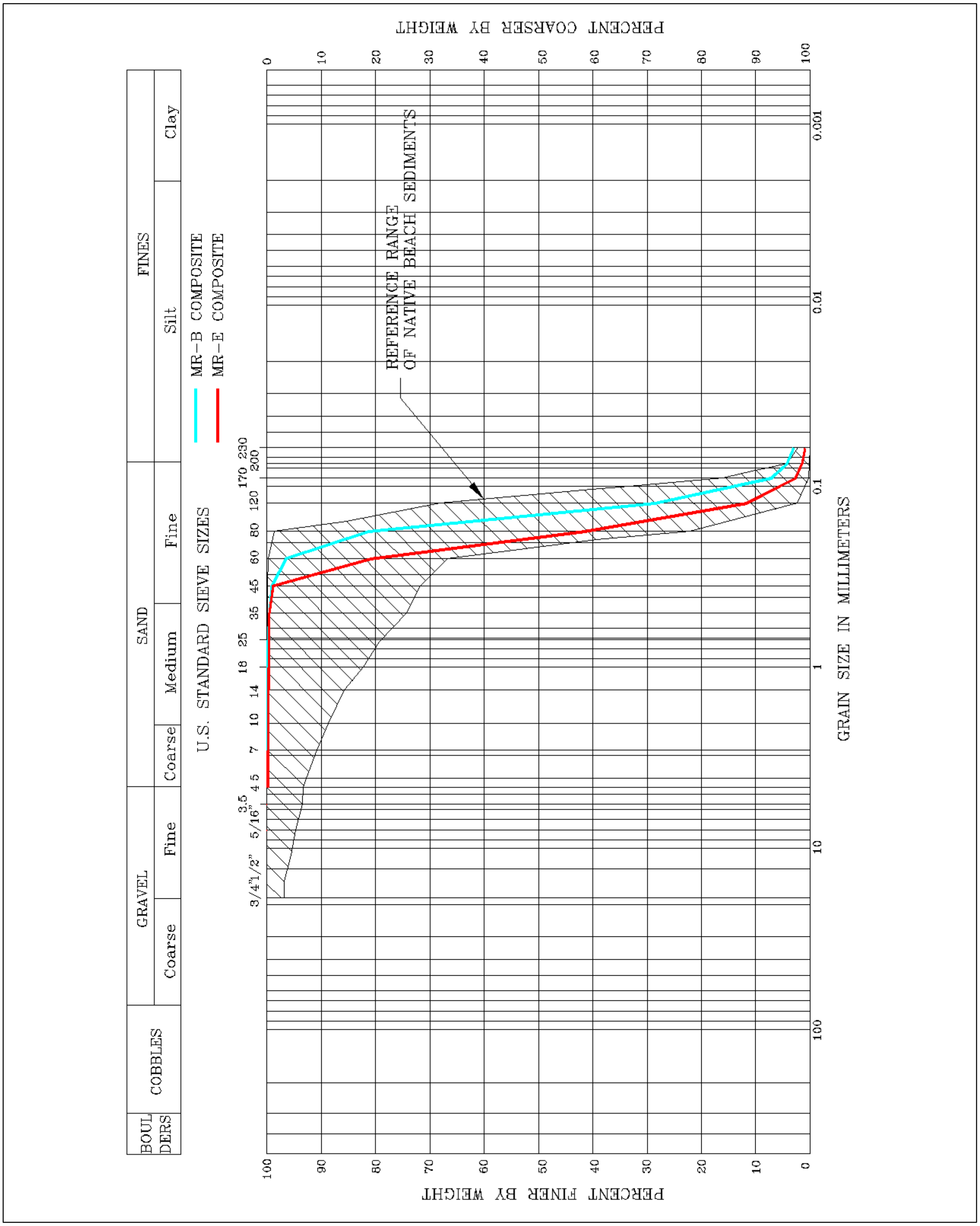


**Figure 7-1: Grain Size Frequency Curves**

**Table 7-2: Renourishment Factor Calculations of River Borrow Area Sediment Samples**

| Sediment Sample Name | $\delta$ | $\sigma$ | $\Delta$ | $R_j$ |
|---|---|---|---|---|
| **Borrow Area MR-B-09** | | | | |
| MRB-08-05C | 0.39 | 0.39 | 1.00 | 2.25 |
| MRB-08-06C | 0.39 | 0.42 | 1.00 | 2.22 |
| MRVC-05-04C | -0.30 | 0.45 | 1.00 | 1.11 |
| MRVC-05-05C | 0.09 | 0.34 | 1.00 | 1.70 |
| MRVC-05-06C | 0.32 | 0.34 | 1.00 | 2.14 |
| | | | ***MR-B-09 Average*** | ***1.89*** |
| **Borrow Area MR-E-09** | | | | |
| MRE-08-05 | -0.36 | 0.43 | 1.00 | 1.05 |
| MRE-08-07C | -0.14 | 0.45 | 1.00 | 1.30 |
| MRE-08-10C | 0.13 | 0.46 | 1.00 | 1.69 |
| MRE-08-11 | 0.18 | 0.40 | 1.00 | 1.82 |
| MRVC-05-07C | -0.36 | 0.42 | 1.00 | 1.06 |
| MRVC-05-10C | -0.29 | 0.65 | 1.00 | 1.00 |
| | | | **MR-E-09 Average** | ***1.32*** |

$\delta =$ $(M_{fcore}-M_{fnative})/s_{fnative}$

$\sigma =$ $s_{fcore}/s_{fnative}$

$\Delta =$ Winnowing Function

$R_{j} =$ $\exp[D(s)-(D^2/2)((s_{fcore}^2/s_{fnative}^2)-1)]$

### 7.1.2 Cut to Fill Ratio

The sediment data presented as part of the Mississippi River Borrow Area Design Analysis (Appendix E) was analyzed for percent fines specifically fine silts and clays that are anticipated to be lost during excavation of the Borrow Areas MR-B-09 and MR-E-09, placement within the beach and dune fill template especially losses to the gulf during construction of the seaward portions of the template, and the overfill ratios. Examining the 20 samples from the eleven (11) cores, the following percentages were derived. The No. 200 sieve fraction ranged from 0.2 to 11.6%, the No. 230 screen fraction ranged from 0.1 to 5.4%, and the pan fraction ranged from 0.4 to 12.0%. Based on the measured percent silts and clays and the calculated overfill ratios, a cut to fill ratio of 1.3 is recommended for estimating the required volume of Mississippi River Borrow Area sediments needed for beach and dune restoration.

## 7.2 Back-Barrier Geotechnical Analysis

### 7.2.1 Introduction

The Scofield Island Back-Barrier Geotechnical Analysis (Appendix K) was conducted to derive the marsh platform and containment dike design criteria. Two primary dikes will be needed for Project construction. The first will contain the marsh fill within the template and prevent fill diffusion into the remainder of Skipjack Bay. The second will separate the beach and dune fill from the marsh fill to contain the Mississippi River sand placed in the seaward portion of the overall fill template. Further, secondary or "interior" containment dikes will be constructed within the marsh fill template to contain the sediment laden water used to deposit the fill material and control return water.

Decreases in the marsh platform and containment dike elevations shall occur over time and are due to the total effective settlement. The total effective settlement is defined as the combination of settlement due to the weight of the fill or dike, self-weight consolidation within the fill or dike, and geologic subsidence.

The source of material for the marsh platform shall be the Scofield Island Offshore Borrow Area (SOBA) (Appendix J). The significant majority of the material sources for the containment dikes shall be in-situ sediments. During the development of the construction plans and technical specifications in the Final Design Task, the material sources and alternatives shall be further evaluated and the preferred alternative for each containment dike in terms of technical and cost effectiveness shall be recommended for inclusion in the Project.

### 7.2.2 Geotechnical Sampling

In October 2008, Eustis Engineering Services, LLC (EES) conducted back barrier geotechnical testing at the Scofield Island Restoration Area to obtain sediment samples for laboratory analysis to determine containment dike design criteria (EES, 2009). Six (6) 50 foot long soil borings were extracted from select locations throughout the projected construction templates including along the marsh fill containment dike, within the marsh fill platform, and within the beach and dune fill (Figure 3-2). From these samples, EES conducted detailed geotechnical analyses and determined the parameters necessary to design the containment dikes for stability with appropriate safety factors and predict the total effective settlement of both the dikes and the marsh fill platform in varying water depths throughout the Project life.

The geologic subsurface profile at the majority of the borings was described by EES as follows. The subsurface consists of a layer of sand ranging in thickness from 0 to 15 feet. Underlying the sand deposits are very soft organic clays varying in thickness from 9 to 25 feet. These marsh deposits are underlain by intradelta deposits of silty sand and sand which are in turn underlain by very soft to soft interdistributary clays down to depth (50 feet below existing grade).

### 7.2.3 Assumptions and Project Parameters

The analysis performed by EES included the following assumptions and Project parameters:

- Mean low water (MLW) elevation = +0.55 feet NAVD88
- Mean high water (MHW) elevation = +1.60 feet NAVD88
- Project life = 20 years
- Geologic Subsidence = 0.025 feet/year
- Sea-level Rise = 0.03 feet/year
- Dike Material Sources = in-situ sediments with wet unit weight of 88 lbs per cf and remodeled shear strength of 100 lbs per sf
- Existing bay bottom depth range along the dike alignments = 0 to -2 feet NAVD88
- Soils below the 50 foot boring depth to a depth of 80 feet assumed to be normally consolidated
- Soils below the 80 foot depth were not considered in the analyses
- Dike crest width = 20 feet
- Dike crest elevation range = +4 to +6 feet NAVD88
- Borrow channel dredge depth (max) = -8 feet NAVD88
- Marsh Fill Material Source = Scofield Island Offshore Borrow Area with wet unit weight of 100 lbs per cf
- Marsh fill placement method = un-compacted methods in standing water
- Target marsh platform elevation range = +2.0 to +3.5 feet NAVD88
- Beach/Dune Fill Material Source = Mississippi River Borrow Areas MR-B-09 and MR-E-09 with wet unit weight of 120 lbs per cf
- Target beach berm elevation range = +4 to +6 feet NAVD88
- Target dune crest elevation range = +6 to +7 feet NAVD88

### 7.2.4 Consolidation and Settlement Analysis

Consolidation tests and settlement estimates were performed by EES to derive the settlement due to the weight of the marsh fill or dike and self-weight consolidation within the fill or dike over time. Geologic subsidence was factored in and time-rates of total effective settlement were computed for various dike and marsh platform elevations in varying bay bottom depths under varying water depths. Fairly rapid settlement caused by the weight of the dike and the influence of the recently placed fill along with self-weight consolidation occurs over the first 2 years following construction. Following the initial 2 years, a steadier settling takes place which is dominated by the fairly constant geologic subsidence. Thus, the containment dike design life is set at 2 years.

### 7.2.5 Marsh Platform

#### 7.2.5.1 Target Elevation

Using the total effective settlement relationships developed by EES for varying bay bottom depths and water depths, a trial and error analysis was performed to determine the optimal design elevation of the marsh construction berm for achieving the Project's design objective for marsh construction. That is, achieve an elevation such that by Year 3 the marsh elevation is within the tidal zone, defined from MHW to MLW, and remains within this zone through Year 20. Figures 7-2 through 7-5 present the results of this analysis for target elevations ranging from +3.5 to +2.0 feet NAVD88. These figures depict the total effective settlement curve of the each target marsh platform elevation for varying depths along with the average. The tidal range (MLW to MHW) accounting for sea level rise at a rate of 0.03 feet per year (Section 4.6) is denoted on the figure along with the rage of measured native marsh elevations (Section 3.2.3.6). Table 7-3 presents a comparison of the different target elevations and the percent time the marsh platform elevation falls within the tidal zone during the Project life. Based on this comparison, the target marsh platform elevation of +3.0 feet NAVD88 is recommended.

**Table 7-3: Marsh Platform Duration within Tidal Zone**

| Proposed Marsh Fill Elevation (ft NAVD88) | Time to Reach MHW (Years) | Time to Reach MLW (Years) | Time within Intertidal Zone (Years) | Percentage of Project Life (%) |
|---|---|---|---|---|
| +3.5 | 6.0 | 20.0 | 14.0 | 70.0 |
| +3.0 | 3.2 | 17.3 | 14.1 | 70.5 |
| +2.5 | 1.1 | 13.3 | 12.2 | 61.0 |
| +2.0 | 0.0 | 9.7 | 9.7 | 48.5 |

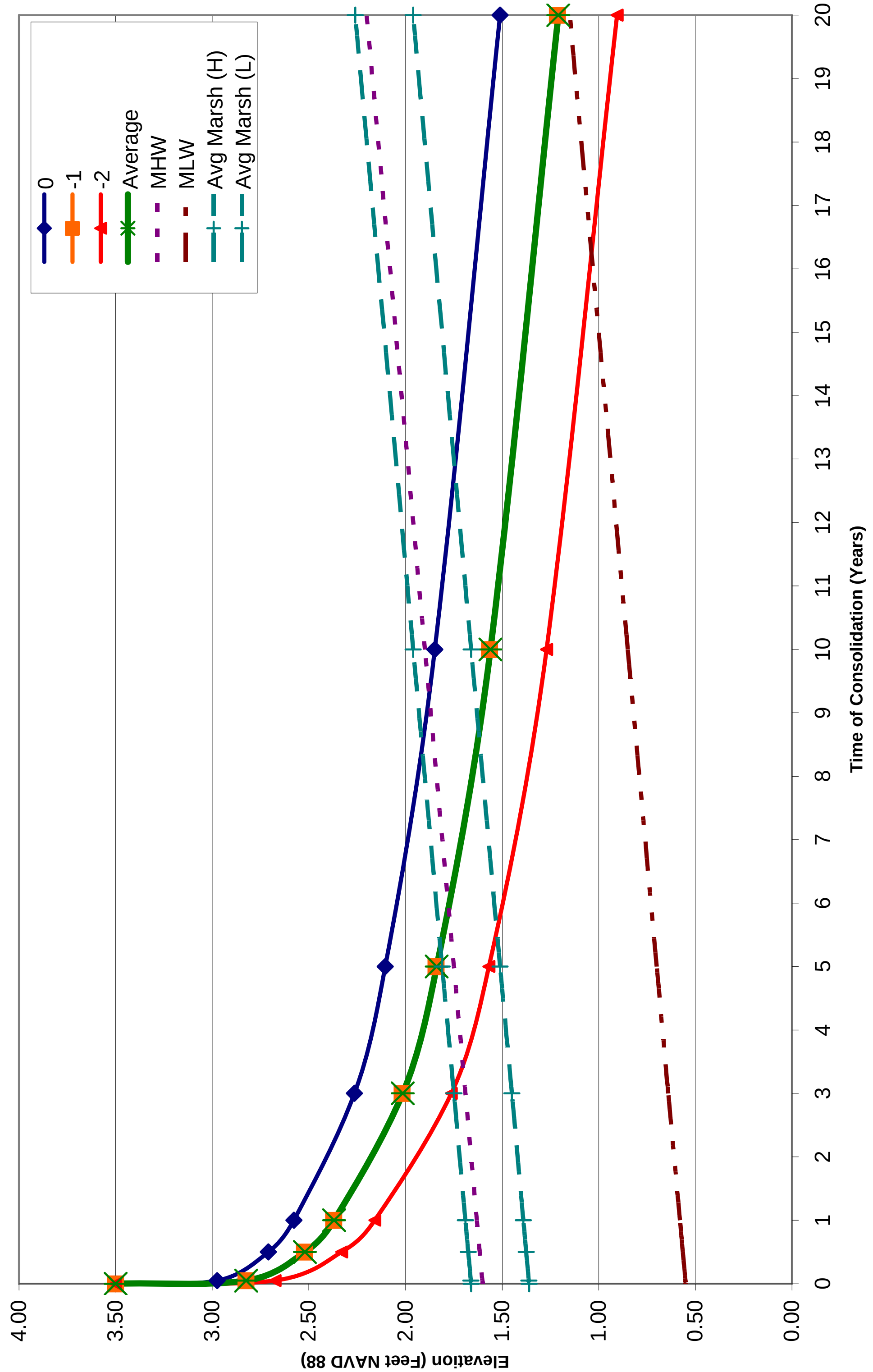


**Figure 7-2: Back-Barrier Marsh Creation Settlement Curve Comparison Elevation +3.5’ NAVD88 (Geologic Subsidence & SLR Included)**

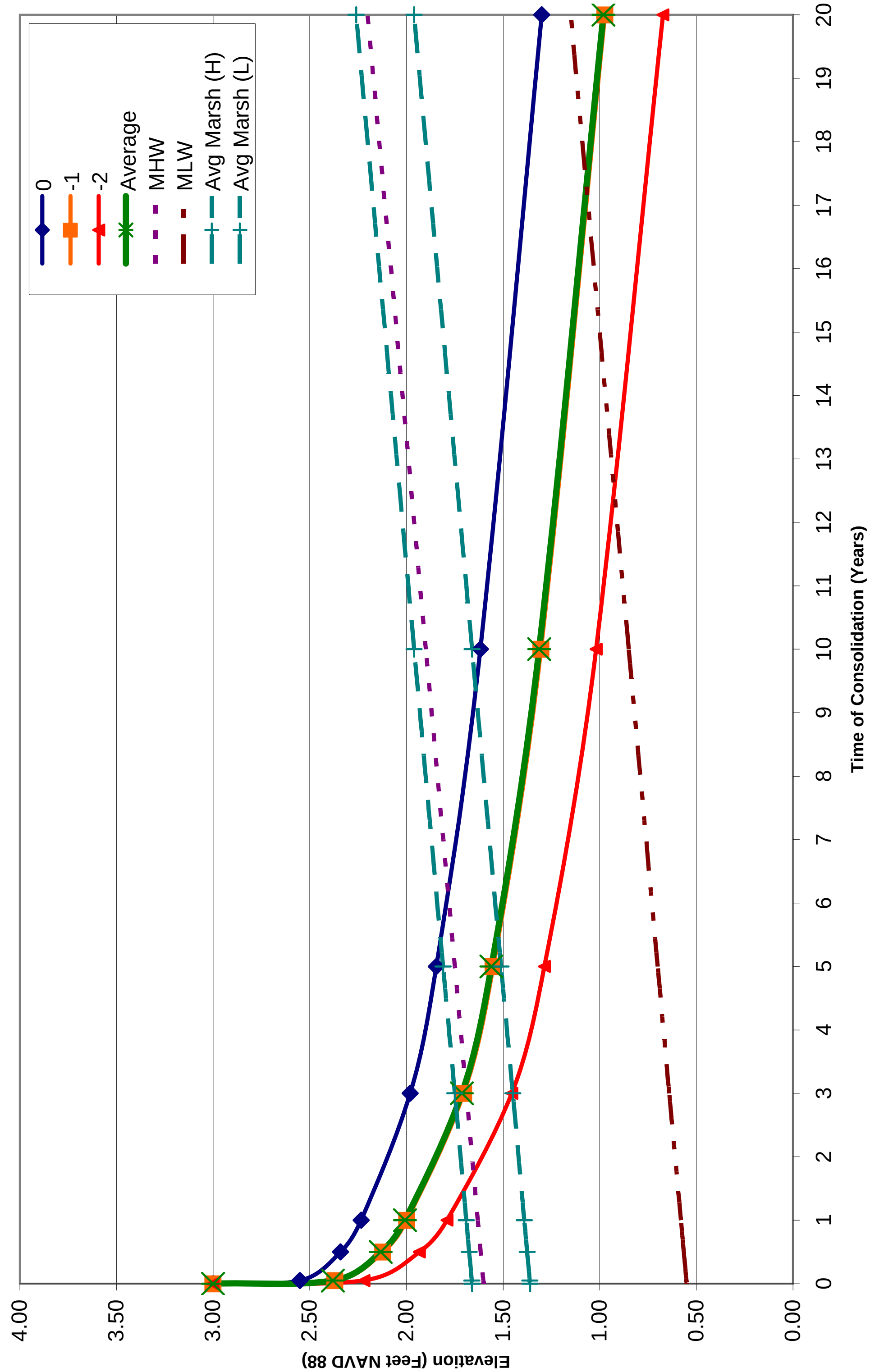


**Figure 7-3: Back-Barrier Marsh Creation Settlement Curve Comparison Elevation +3.0’ NAVD88 (Geologic Subsidence & SLR Included)**

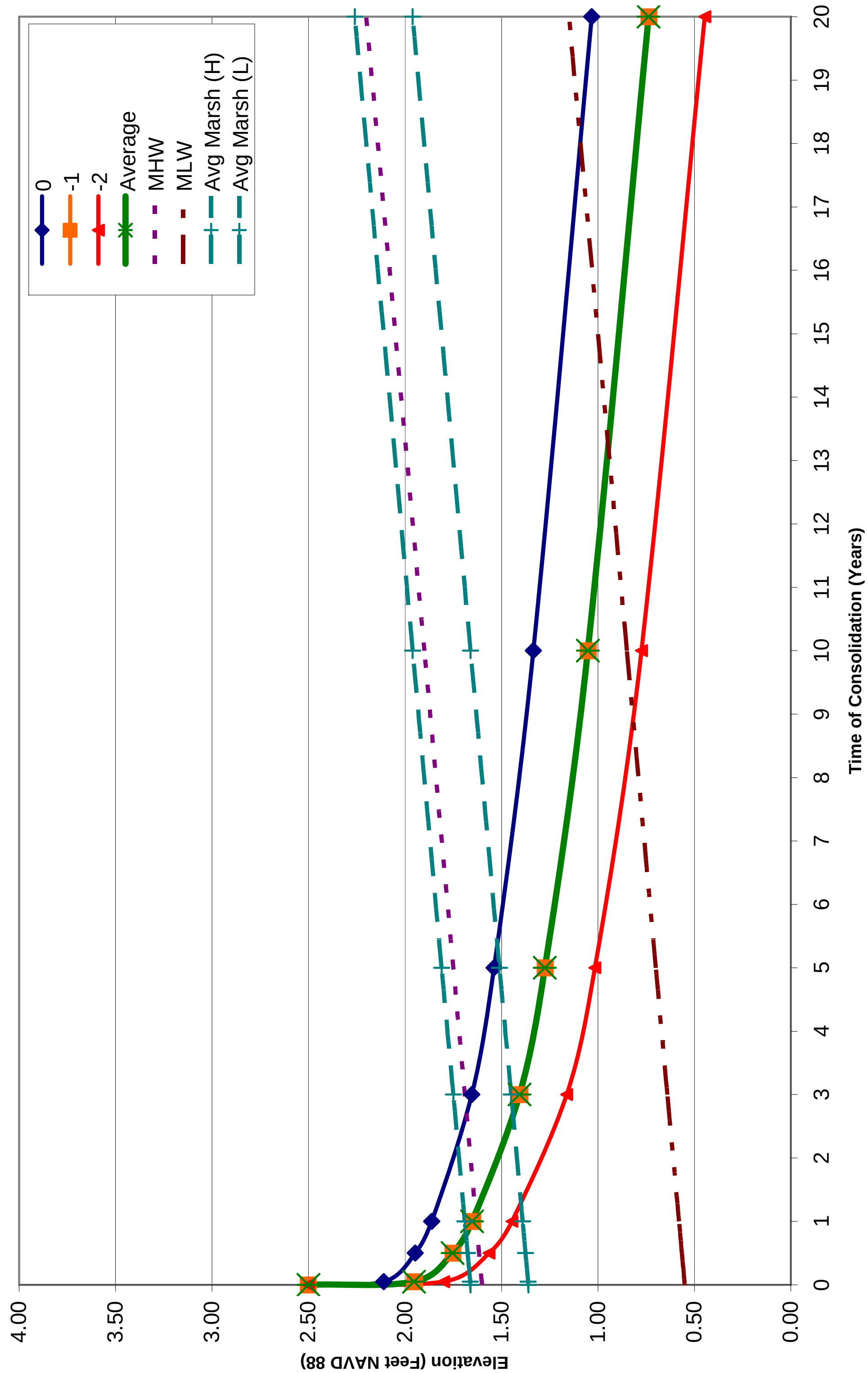


**Figure 7-4: Back-Barrier Marsh Creation Settlement Curve Comparison Elevation +2.5’ NAVD88 (Geologic Subsidence & SLR Included)**

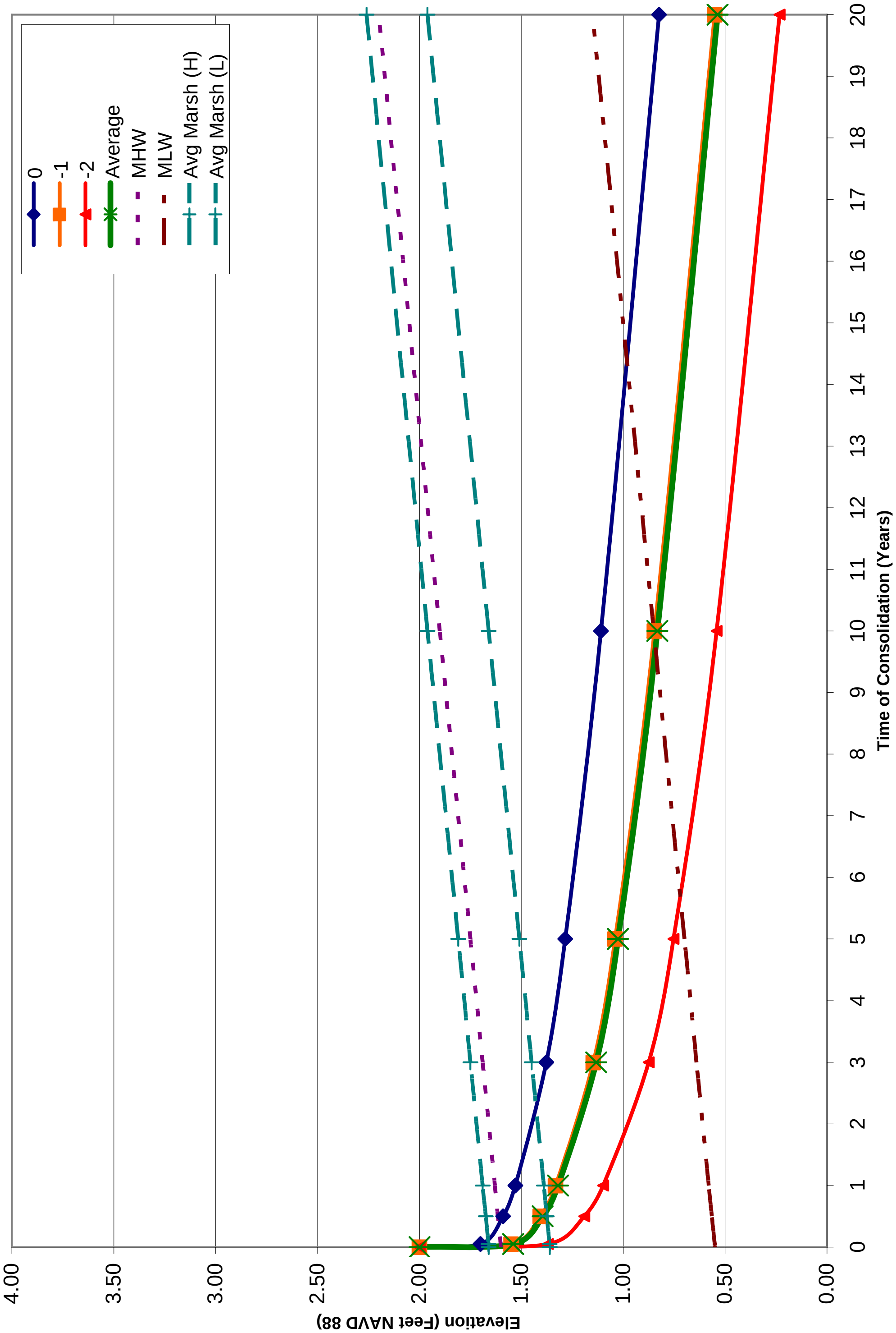


**Figure 7-5: Back-Barrier Marsh Creation Settlement Curve Comparison Elevation +2.0' NAVD88 (Geologic Subsidence & SLR Included)**

#### 7.2.5.2 Cut to Fill Ratio

The sediment data presented as part of the SOBA Design Analysis (Appendix J) were analyzed for percent fines specifically fine silts and clays that are anticipated to be lost during excavation of SOBA and placement within the marsh fill template including dewatering. Examining the 24 samples from the seven (7) cores, the following percentages were derived. The No. 200 sieve fraction ranged from 0.8 to 23.2%, the No. 230 screen fraction ranged from 0.5 to 38.3%, and the pan fraction ranged from 3.0 to 78.0%. The combined fraction for all three for all the samples was 53.4% of the dry weight. Based on the measured percent silts and clays, a cut to fill ratio of 1.6 is recommended for estimating the required volume of SOBA sediments needed for marsh construction.

### 7.2.6 Slope Stability Analysis

EES conducted slope stability analyses by a two-dimensional limit equilibrium stability analysis of selected trial failure surfaces to evaluate containment dike and borrow channel side slopes. Their recommended factor of safety was 1.3 and was based on Spencer's Method of Slices. Based on their analyses, EES recommended a 1 vertical on 8 horizontal side slope for the containment dikes allowing for achieving a dike crest elevation of +4 and +6 feet NAVD88 for existing bay bottom elevations of -2 and 0 feet NAVD88, respectively. Applying the same factor of safety and assuming a 1 vertical on 3 horizontal side slope for the borrow channels, EES determined a recommended buffer distance from the toe of the containment dike to the top of the borrow channel cut equal to 30 and 40 feet for bay bottom depths of -2 and 0 feet NAVD88, respectively. These criteria were utilized to design the containment dike templates presented in the recommended plan typical sections (Section 8.0).

### 7.2.7 Borrow Channel Cut to Dike Fill Ratios

Based upon their experience and research, EES recommended a cut to fill ratio of 2:1 for the mechanical excavation and placement of in-situ sediments with natural moisture contents ranging from 40% to 60%, and for higher moisture contents, a ratio of 3:1. Therefore, the borrow areas / floatation channels shall be designed during the development of the construction plans and technical specifications in the Final Design Task to provide ample in-situ sediments to construct the containment dikes applying these ratios.

### 7.2.8 Marsh Fill Containment Dike

The primary dike for the marsh platform will be sited along the northern boundary of the marsh fill template. The bay bottom depths along this boundary are approximately -1.5 to -2.0 feet

NAVD88. In order to maintain a conservative estimate of material that may be needed to construct this dike, the design toe elevation of -2 feet NAVD88 was used. Using the total effective settlement relationships developed by EES for varying bay bottom depths and water depths, a trial and error analysis was performed to determine the design dike elevation which meets and exceeds the 2-year design criteria. Figures 7-6 through 7-8 depict the total effective subsidence for different dike crest elevations. The total effective subsidence increases for increasing vertical difference between the dike crest and bay bottom primarily due to the weight of the extra material required to reach the water surface. The tidal range (MLW to MHW) accounting for sea level rise is denoted on the figures. The containment dikes along the perimeter of the marsh fill sections may be degraded or gapped at a later date where observed settlements are less than anticipated to promote hydrologic exchange.

#### 7.2.9 Beach and Dune Fill Containment Dike

The primary dike for the beach and dune fill will be sited along the southern limit of the marsh fill corresponding to the northern limit of the beach/dune fill interface. The general native soil elevations along this boundary range from +2.0 to -1.5 feet NAVD88 with an average of -0.6 feet NAVD88, which shall be used to maintain an estimate of material that may be needed to construct this dike.

Using the total effective settlement relationships developed by EES for varying bay bottom depths and water depths, a trial and error analysis was performed to determine the design dike elevation, which meets and exceeds the 2-year design criteria. Figures 7-9 and 7-10 depict the total effective subsidence for dike crest elevations at +6.0 and +4.0 feet NAVD88, respectively. The total effective subsidence increases for increasing vertical difference between the dike crest and bay bottom primarily due to the weight of the extra material required to reach the water surface. The tidal range (MLW to MHW) accounting for sea level rise is denoted on the figures. Interpolating between these two values yielded the recommended dike crest elevation of +4.9 feet NAVD88 (Figure 7-11) which coincides with the marsh fill containment dike elevation. The containment dike separating the beach fill from the marsh fill will be degraded to provide a smooth transition between the two fill areas.

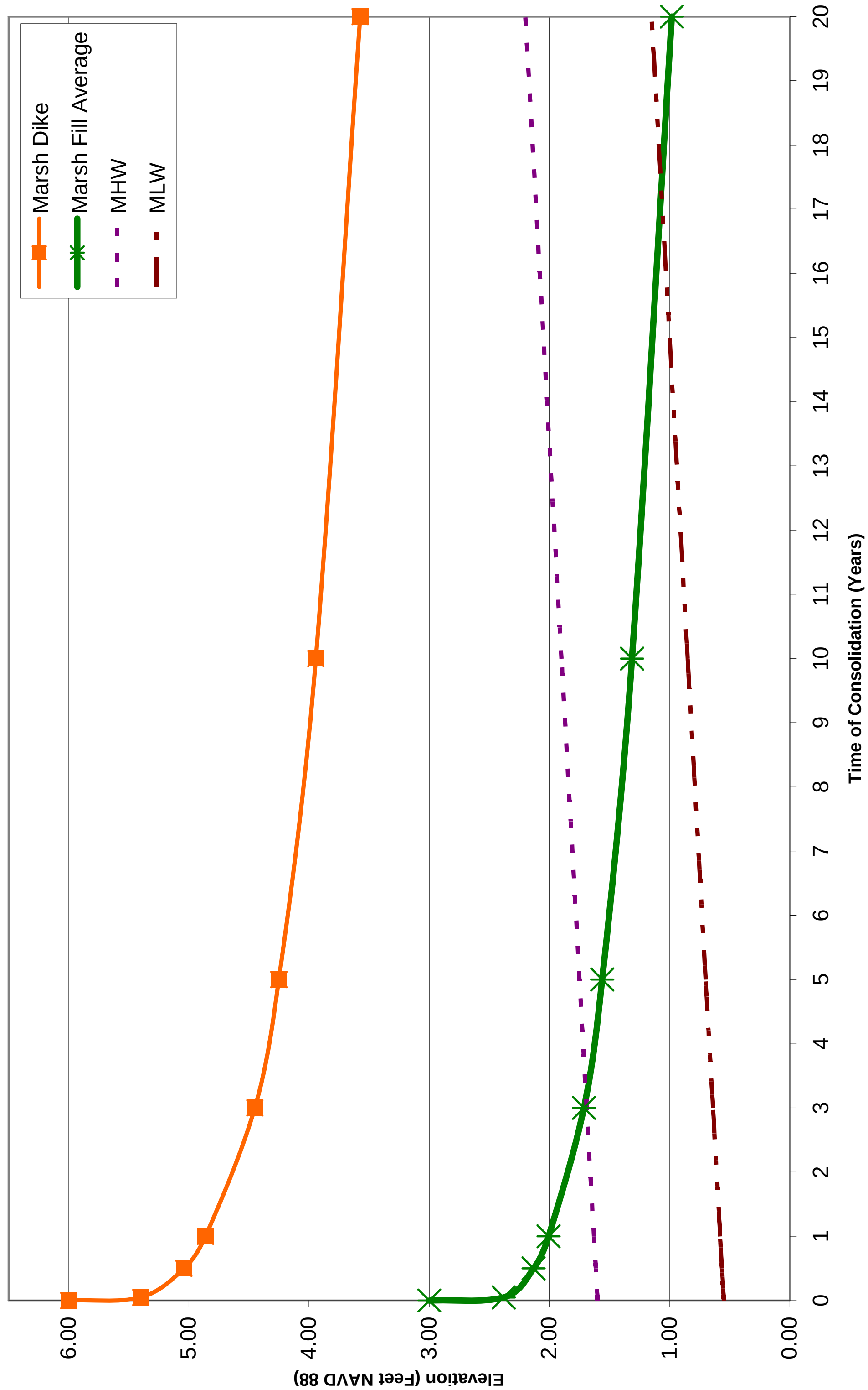


**Figure 7-6: Marsh Fill Containment Dike +6.0’ NAVD88, Settlement Curve Comparison vs. Marsh Fill Elevation of +3.0’ NAVD88 (Geologic Subsidence & SLR Included)**

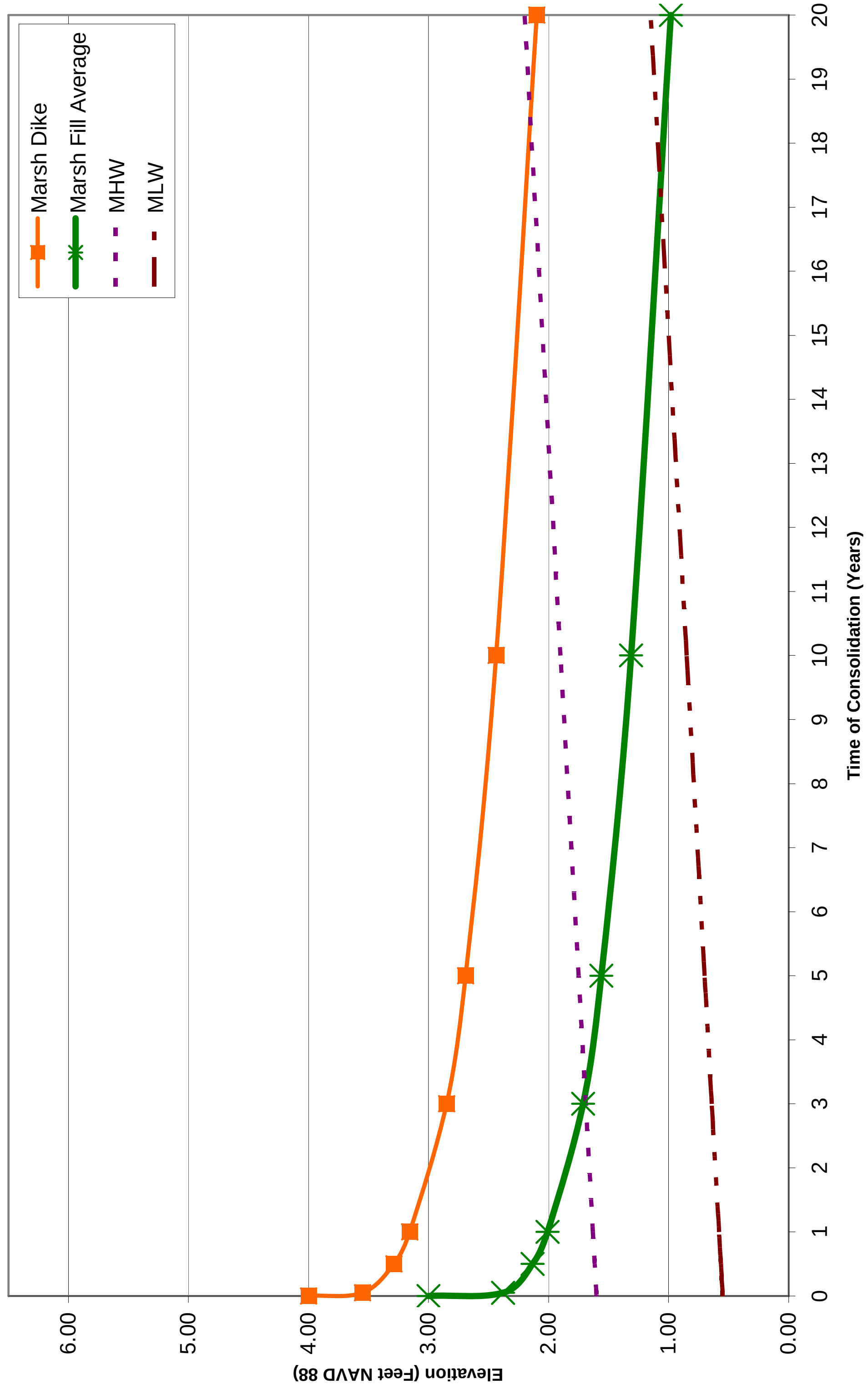


**Figure 7-7: Marsh Fill Containment Dike +4.0' NAVD88, Settlement Curve Comparison vs. Marsh Fill Elevation of +3.0' NAVD88 (Geologic Subsidence & SLR Included)**

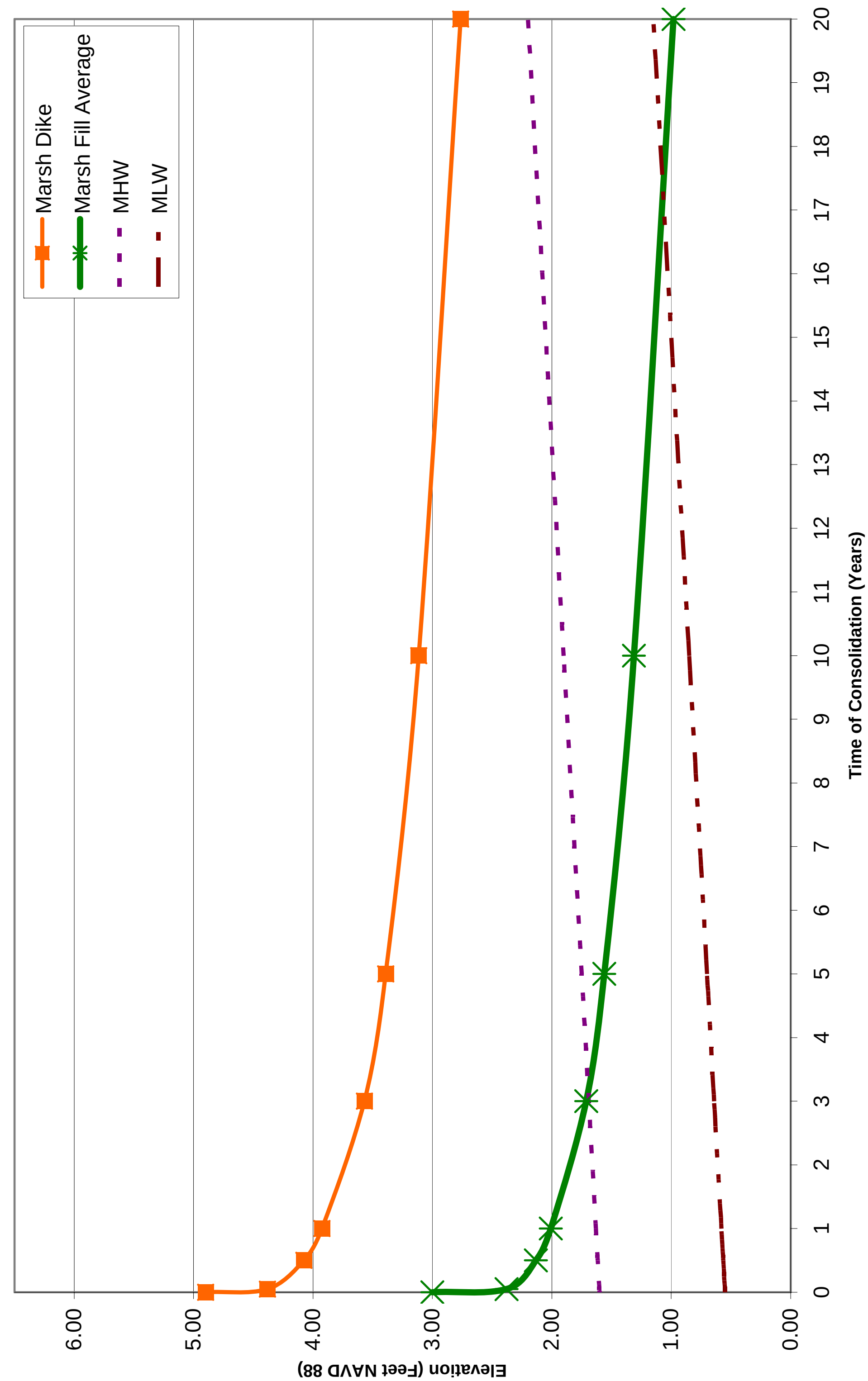


**Figure 7-8: Marsh Fill Containment Dike +4.9' NAVD88, Settlement Curve Comparison vs. Marsh Fill Elevation of +3.0' NAVD88 (Geologic Subsidence & SLR Included)**

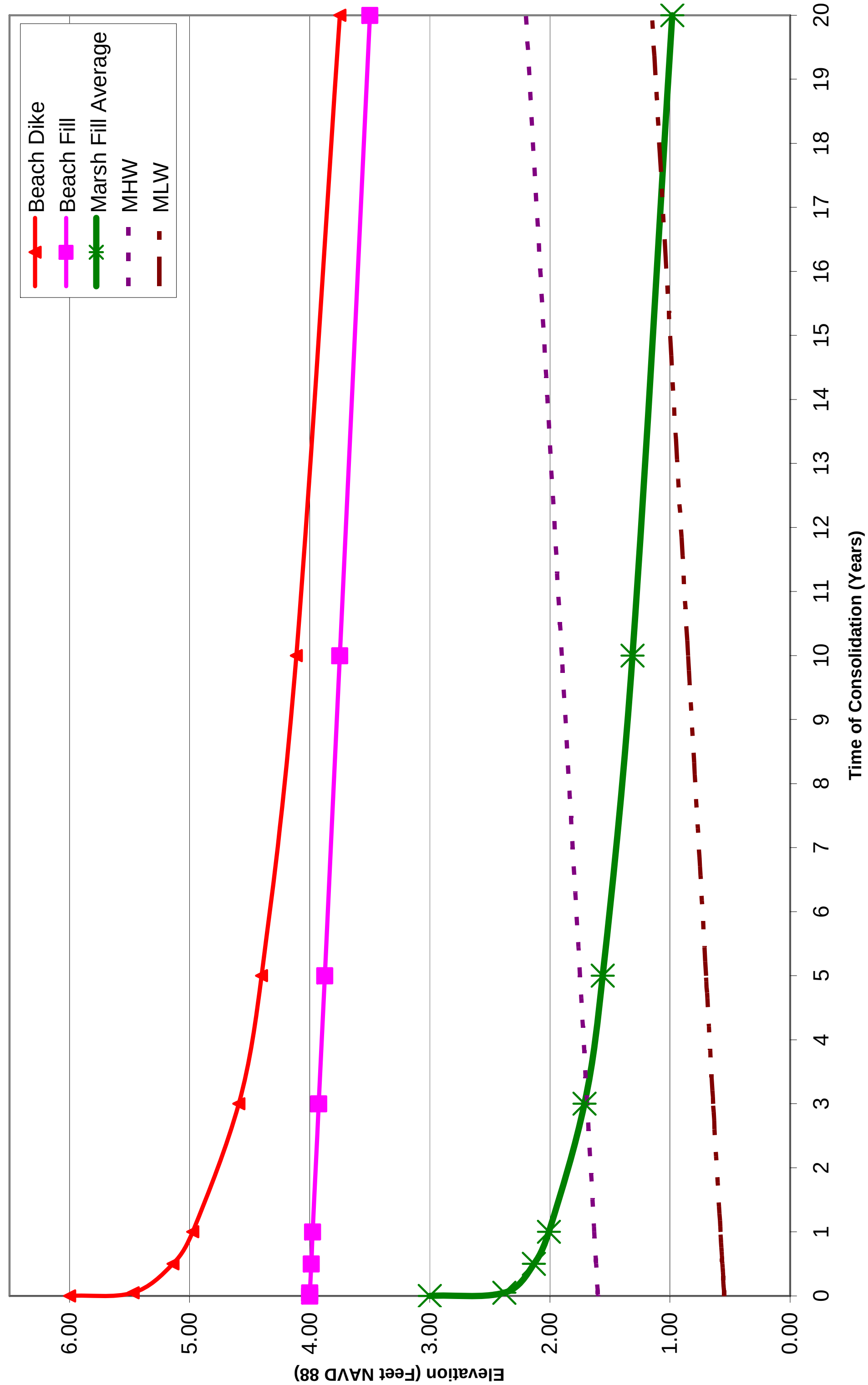


**Figure 7-9: Beach and Dune Containment Dike +6.0' NAVD88, Settlement Curve Comparison vs. Target Beach and Marsh Elevations (Geologic Subsidence & SLR Included)**

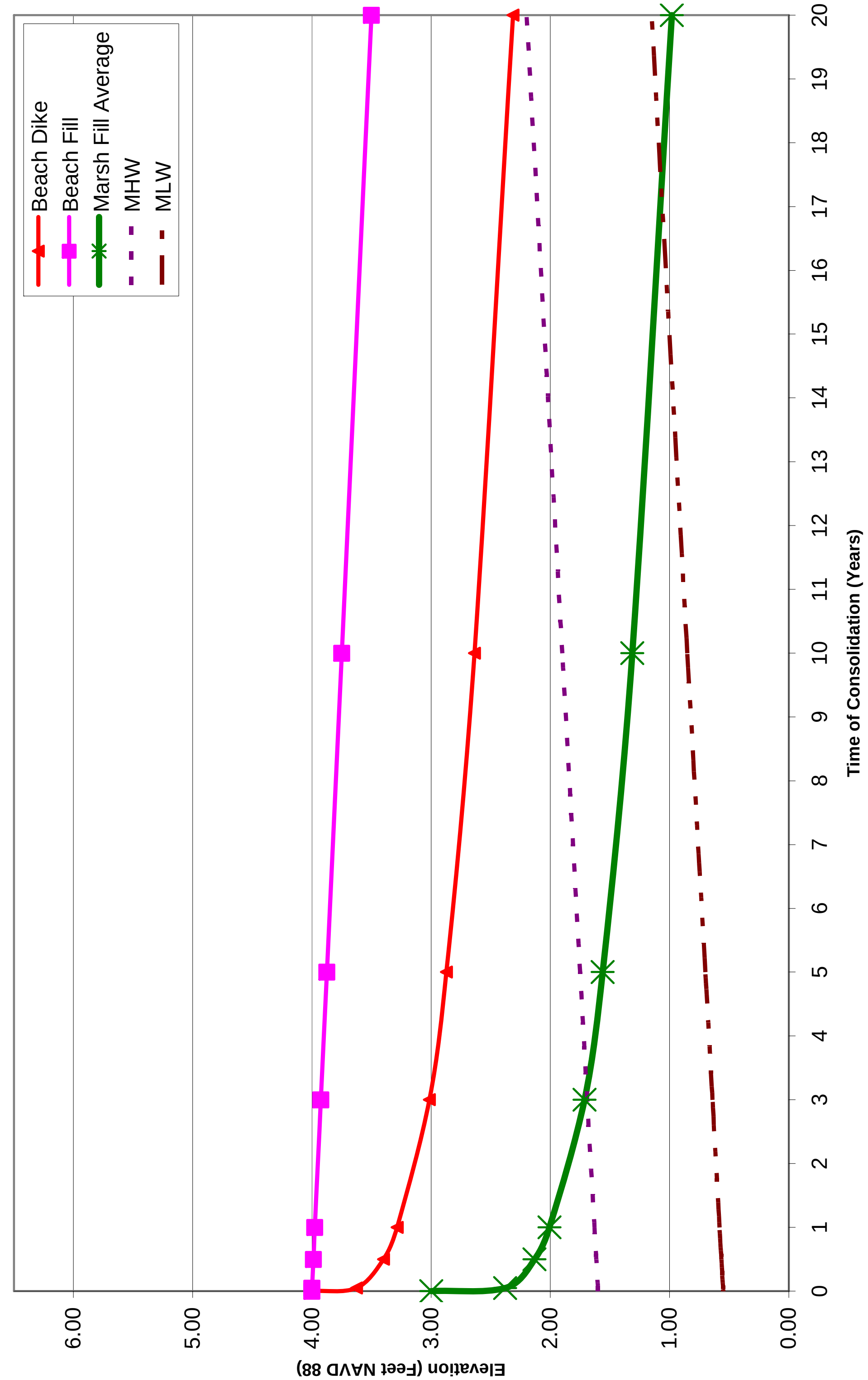


**Figure 7-10: Beach and Dune Containment Dike +4.0’ NAVD88, Settlement Curve Comparison vs. Target Beach and Marsh Elevations (Geologic Subsidence & SLR Included)**

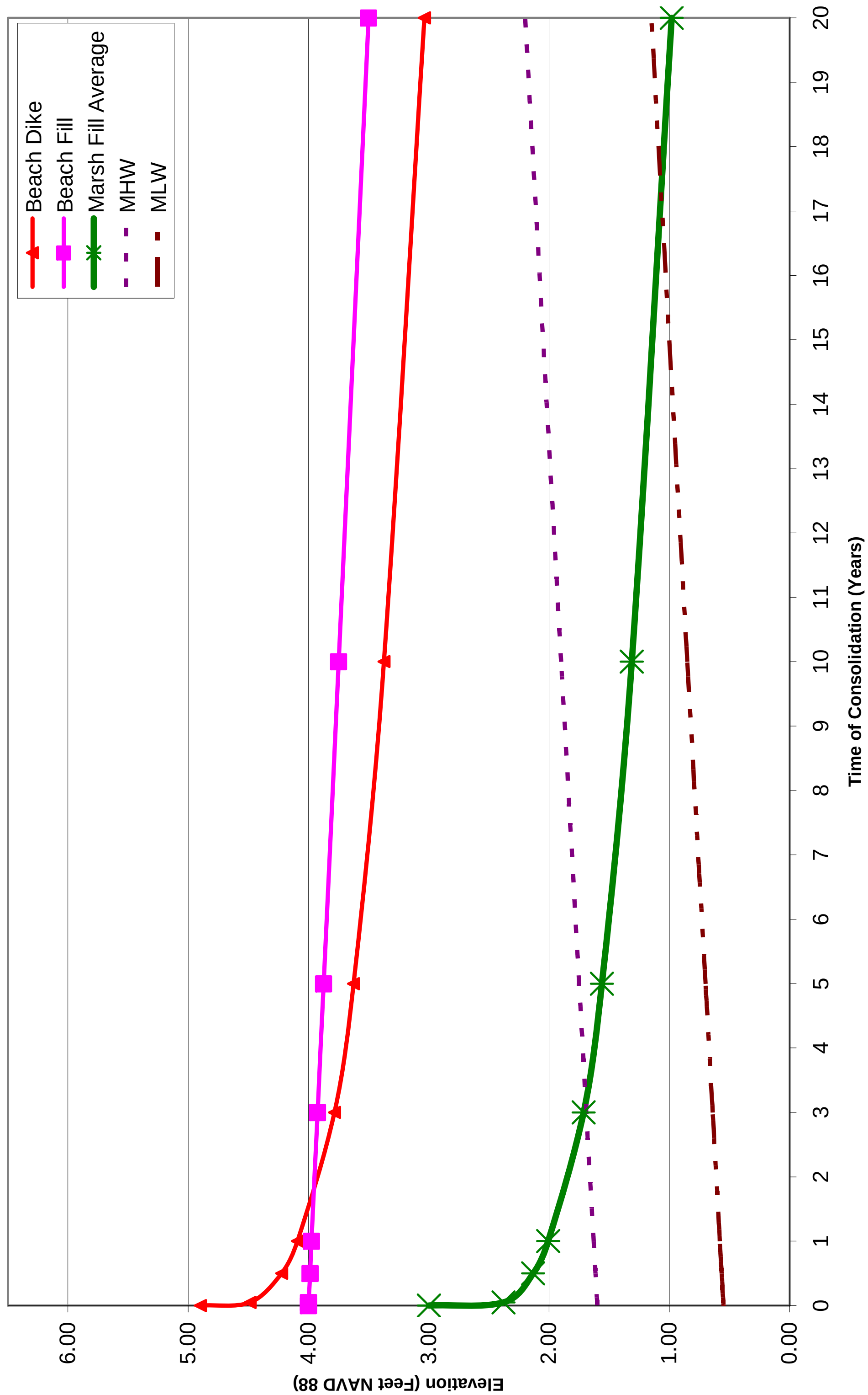


**Figure 7-11: Beach and Dune Containment Dike +4.9' NAVD88, Settlement Curve Comparison vs. Target Beach and Marsh Elevations (Geologic Subsidence & SLR Included)**

## 8.0 RECOMMENDED DESIGN ALTERNATIVE

### 8.1 Ranking Criteria

Three (3) design alternatives were identified in the Alternatives Analysis (Section 6.0) as being feasible to pursue for achieving the Project goals for the restoration of Scofield Island. In order to recommend the optimal alternative, the following ranking criteria were established for the technical, environmental, and fiscal evaluation parameters.

- Achieving design objective for creating target habitat acres
- Achieving design objective for sustaining target habitat acres
- Providing storm protection for Project life, that is, prevent island breaching
- Preliminary Opinion of Cost

Table 8-1 summarizes the analysis of habitat acres created and sustained during the Project life. The values were normalized by the CWPPRA goal values.

**Table 8-1: Summary of Habitat Acres**

| Habitat | Alternative 2 (Ac) | Alternative 3 (Ac) | Alternative 4 (Ac) |
|---|---|---|---|
| Creation Goal | 429 | 429 | 429 |
| Total Created | 561.6 | 568.9 | 600.6 |
| Normalization | 1.31 | 1.33 | 1.40 |
| Sustained Goal | 278 | 278 | 278 |
| Total Sustained | 437.2 | 404.0 | 476.1 |
| Normalization | 1.57 | 1.45 | 1.71 |

Based upon the storm protection benefit analysis, Alternative 4 provides a higher level of storm protection compared to Alternatives 2 and 3 and Alternative 4 is the preferred alternative. However, for all of these alternatives, the beach and dune fill is predicted to remain intact to provide the marsh with sufficient protection to prevent severe damage and breaching during the Project life. Thus all three alternatives scored a 1.0.

To evaluate the costs, two methods were chosen. First, the preliminary opinion of construction costs was compared to the CWPPRA conceptual restoration plan budget on the order of $40,000,000. The normalization value was obtained by subtracting the original cost from the alternative cost, then dividing by the original cost, then subtracting from 1.0. Table 8-2 presents the summary of this analysis.

**Table 8-2: Summary of Costs**

| Alternative | Preliminary Opinion of Cost | Normalization |
|---|---|---|
| 2 | $49,415,000 | 0.76 |
| 3 | $47,579,000 | 0.81 |
| 4 | $50,582,000 | 0.74 |

The second method compared the ratio of each alternative's cost-to-benefit acreage to the ratio of the original cost-to-target acreage sustained for the Project life, equal to $143,885 per acre. The values were normalized by dividing each alternative's ratio by the ratio of the original cost- to-target acreage ratio. Table 8-3 presents the summary of this approach.

**Table 8-3: Summary of Cost-to-Benefit Acres**

| Alternative | Cost per Benefit Acre at TY 20 | Normalization |
|---|---|---|
| 2 | $113,026 | 1.27 |
| 3 | $117,770 | 1.22 |
| 4 | $106,242 | 1.35 |

Based on the ranking criteria, summarized in Table 8-4, the alternatives scored as follows:

- Alternative 2 – 5.91
- Alternative 3 – 5.81
- Alternative 4 – 6.20

**Table 8-4: Summary of Ranking Criteria**

| Alternative | Habitat Acres Created | Habitat Acres Sustained | Storm Protection | Project Costs | Cost to Benefit | Total |
|---|---|---|---|---|---|---|
| 2 | 1.31 | 1.57 | 1.00 | 0.76 | 1.27 | 5.91 |
| 3 | 1.33 | 1.45 | 1.00 | 0.81 | 1.22 | 5.81 |
| 4 | 1.40 | 1.71 | 1.00 | 0.74 | 1.35 | 6.20 |

Alternative 4 scored the highest while Alternative 2 was next and Alternative 3 was the lowest. Alternative 4 is recommended for the Project as the alternative that best achieves the design objectives and balances the technical, environmental, and fiscal evaluation parameters. While it is the most expensive alternative, it yields the highest benefit acreage at TY 20 while its cost to benefit acre is the lowest.

## 8.2 Recommended Design Alternative Description

The Recommended Design Alternative includes two primary components, the beach and dune fill and the marsh platform. The beach and dune fill is approximately 10,600 feet long. The gulfward limits of the beach fill are approximately aligned with the current shoreline position thus the majority of Scofield Island is covered by the proposed beach and dune fill. The dune component includes a 200 foot wide crest width at +6 feet NAVD88 with 1:45 side slopes. The beach fill template includes a 100 foot wide construction berm at +4 feet NAVD88 with 1:45 side slopes. The elevations were chosen to correspond to storm surge levels between the 5- and 10- year storm events to minimize overtopping into the marsh. The average beach fill width measured at MHW is approximately 950 feet. The surface area of the proposed beach platform is approximately 267 acres measured at +4 feet NAVD88. The required fill volume is approximately 2.03 million cubic yards including the preliminary design criteria for the overfill ratio and two years of background erosion equal to the gulf-side erosion less the overwash. The required excavation volume including the preliminary design criteria for the cut to fill ratio is approximately 2.64 million cubic yards.

The marsh platform is approximately 12,000 feet long by 1,100 feet wide on the bay side of Scofield Island. The marsh is also placed west of the beach fill on the west end of the island. The surface area of the proposed marsh platform is approximately 299 acres. The target marsh platform elevation is +3.0 feet NAVD88 accounting for the preliminary design criteria on average existing marsh elevation, sea level rise, subsidence and consolidation. The required fill volume is approximately 1.88 million cubic yards. The required excavation volume including the preliminary design criteria for the cut to fill ratio is approximately 3.01 million cubic yards.

The marsh fill containment dike will be approximately 20,300 linear feet long and require approximately 840,000 cubic yards to construct the design template assuming a borrow channel cut to dike fill ratio of 2:1. The beach and dune fill containment dike will be approximately 11,800 linear feet long and require approximately 323,000 cubic yards to construct the design template assuming a borrow area / floatation channel cut to dike fill ratio of 2:1.

The Preliminary Opinion of Construction Cost including 15% contingencies was determined to be approximately $50,260,000. The total acres created at TY 1 were computed to be approximately 600 acres and the acres sustained at TY 20 was predicted to be approximately 476 acres, which exceeds the CWPPRA conceptual restoration goals. Alternative 4 is recommended for the Final Design Phase.

The recommended design alternative for the Scofield Island Restoration Area is presented in Figure 8-1, plan view, and Figures 8-2 and 8-3, typical cross-sections.

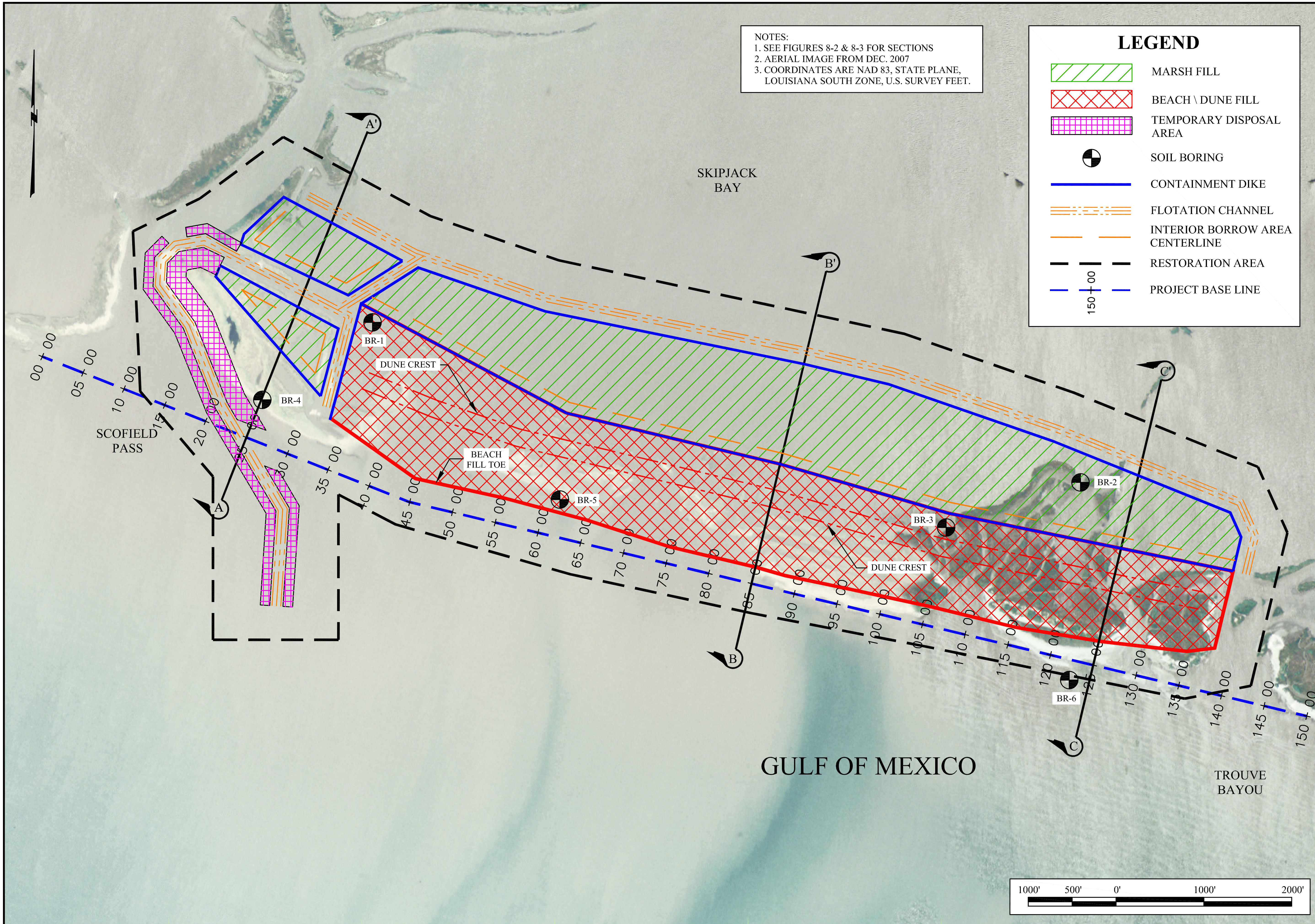


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FIGURE 8-1: SCOFIELD ISLAND RECOMMENDED ALTERNATIVE PLAN VIEW

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BATON ROUGE, LA. 70821
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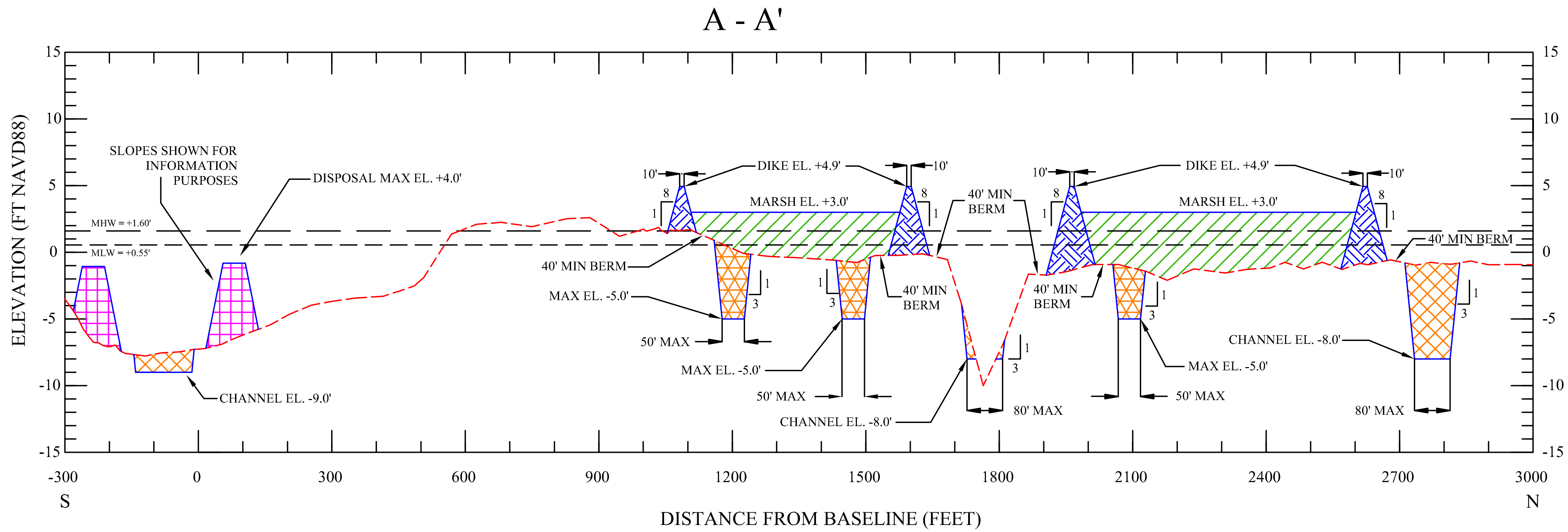
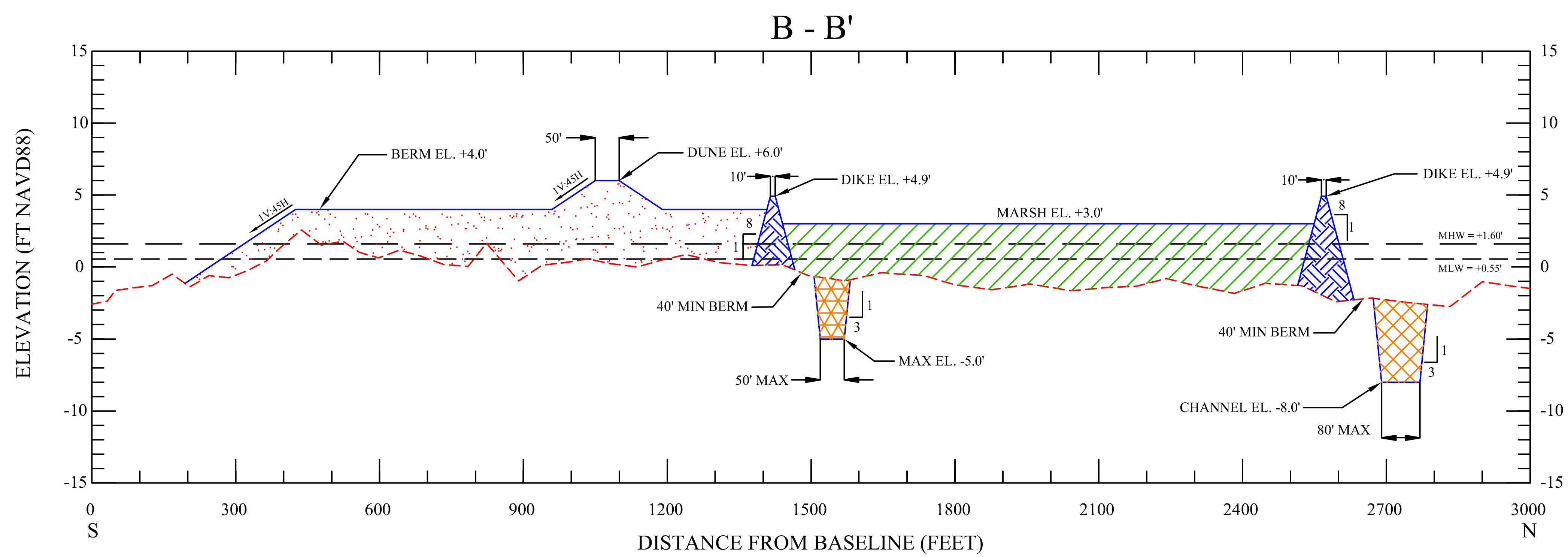
LEGEND:

- BEACH / DUNE FILL
- MARSH FILL
- CONTAINMENT DIKE
- CONTAINMENT DIKE INTERIOR BORROW AREA
- FLOATATION CHANNEL / CONTAINMENT DIKE BORROW AREA
- SIDECAST DISPOSAL AREA
- JULY 2008
- DESIGN




NOTES:
1. SECTIONS ARE VIEWED AS LOOKING WEST.
2. MARSH FILL TOLERANCE = ±0.5 FEET.
3. BEACH FILL TOLERANCE = ±0.5 FEET.

SCALE:
HORIZONTAL: 1" = 300'
VERTICAL: 1" = 10'

# FIGURE 8-2: SCOFIELD ISLAND RECOMMENDED ALTERNATIVE TYPICAL SSECTIONS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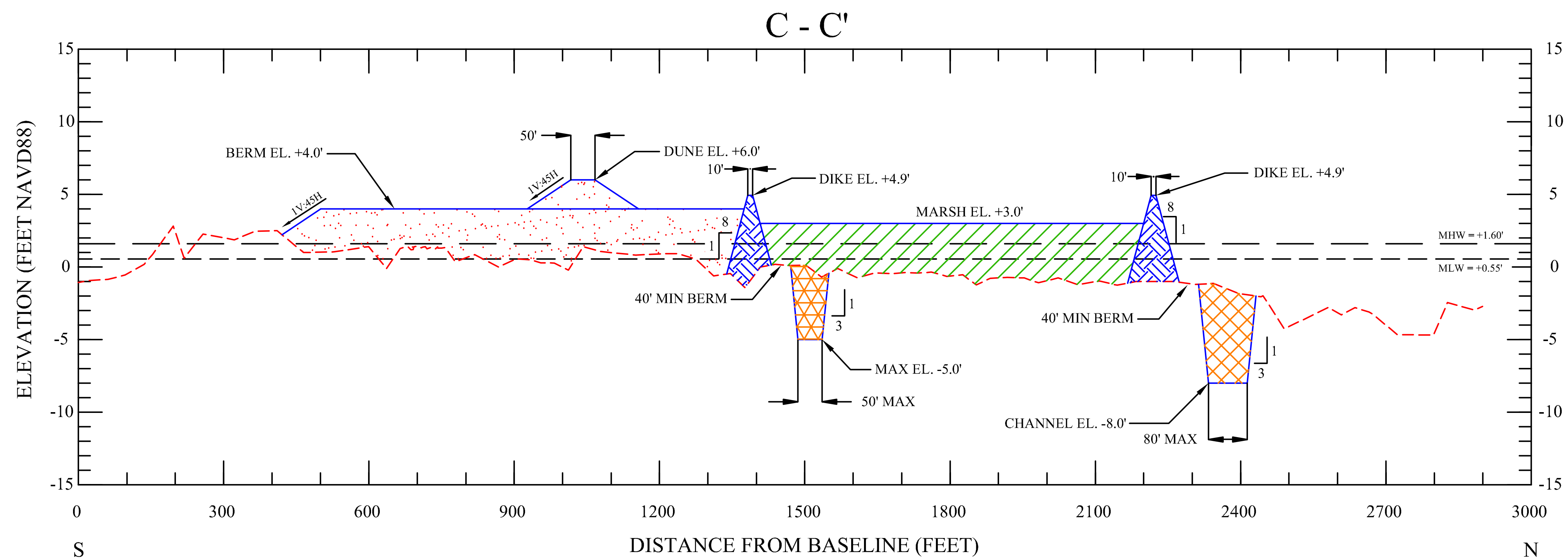
LEGEND:

- BEACH / DUNE FILL
- MARSH FILL
- CONTAINMENT DIKE
- CONTAINMENT DIKE INTERIOR BORROW AREA
- FLOATATION CHANNEL / CONTAINMENT DIKE BORROW AREA
- JULY 2008
- DESIGN




NOTES:
1. SECTIONS ARE VIEWED AS LOOKING WEST.
2. MARSH FILL TOLERANCE = ±0.5 FEET.
3. BEACH FILL TOLERANCE = ±0.5 FEET.

SCALE:
HORIZONTAL: 1" = 300'
VERTICAL: 1" = 10'


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FIGURE 8-3: SCOFIELD ISLAND RECOMMENDED ALTERNATIVE TYPICAL SECTION


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